CHAPTER 2
ALTERNATIVES DEVELOPMENT AND DESCRIPTION

This chapter explains the process used to develop the reclamation alternatives, defines the alternatives eliminated from detailed analysis, and then describes each alternative considered. Sections describing reclamation actions common to all alternatives are included to reduce repetition in the later alternative descriptions. The individual reclamation alternative descriptions for each mine are presented to illustrate the differences among the alternatives. Additional detail on the individual alternatives are shown in Section 2.4, Figures 2.4-3 through 2.4-14.

Section 2.6 discusses the agencies' identification of a preferred alternative for reclamation at each mine, explains how the preferred alternative might be implemented, and discusses the need for "backup" preferred alternatives. Toward the end of this chapter are two sections with summary tables and graphs to compare the alternatives and their predicted impacts. Tables 2.7-1 and 2.7-2 compare the different reclamation actions of each alternative. Tables 2.8-1 and 2.8-2 summarize the environmental impacts of each alternative based upon the analysis presented in Chapter 4. Figures 2.8-1 and 2.8-2 display the alternatives' estimated implementation costs versus environmental benefit in a manner that provides for a cost-benefit comparison of the different reclamation alternatives.

2.1 SIGNIFICANT ISSUES and ALTERNATIVES

The purpose of the alternatives is to provide decisionmakers with a means to consider and resolve the issues. The resolution of significant issues forms the framework of an alternative, with the resolution of lesser issues included around the alternative's central theme. This section describes how the significant issues drove the formulation of the alternatives.

The development of the alternatives centered on addressing six general reclamation issues: 1) final amounts of mine pit backfill; 2) relocation of mine waste facilities; 3) drainage of mine pits, especially at the Landusky Mine; 4) protection/restoration of water quality and quantity; 5) reclamation grading, cover design, and revegetation; and 6) restoration of area aesthetics and land use.

Mine Pit Backfill

The amount of mined waste rock and spent ore that must be backfilled into the open pits as part of mine reclamation is a significant issue for both economic and environmental reasons at the Zortman and Landusky Mines (FEIS, Section 2.2.5). Economic considerations include the high cost that can be associated with even a modest amount of backfilling. To place even the closest waste rock back into the pits could easily cost $1 per ton. This unit cost escalates quickly the farther the material has to be hauled. If the haul involves moving the material uphill, the unit cost increases even more rapidly. Costs of over $4 per ton could be incurred for backfilling some of the material at the mines. Considering that over 200 million tons of ore and waste rock have been mined, backfilling even a fraction of it would cost tens of millions of dollars.

On the environmental side of the issue, pit backfilling can be used to mitigate many of the impacts resulting from mining. Rock placed in the Zortman and Landusky mine pits could be used to protect water quality by controlling surface drainage and covering pit highwalls that contain sulfide minerals in concentrations high enough to release acid and metals during weathering. Backfilling of mine pits could be used to reduce the visual and cultural impacts of the mine disturbance on American Indian traditional cultural activities and on recreationists visiting the public lands. Backfilling can also reduce or eliminate the safety hazard posed by pit highwalls.

Conversely, backfilling activities can create their own impacts through emission of earthmoving equipment exhaust, dust, and noise. In addition, the nature of the backfilled material and its placement can significantly increase environmental risks to surface or groundwater and may adversely affect revegetation success.

It should be noted that there is an upper limit on the amount of backfilling that is possible. It is not technically feasible to backfill 100% of the mined material due to the increase in volume that occurs when rock is broken during mining. All the mined rock will not fit back in the pits. In addition, some of the original pre-mine slopes were steeper than 2H:1V. If these slopes were reconstructed using backfill to their original configuration, they would be more susceptible to erosion or failures than the adjacent slopes which had developed naturally.

Alternatives developed in response to this issue cover the full range of possible pit backfilling options. All Zortman Mine reclamation alternatives would require backfilling and grading of the mine pit floors to achieve a free draining condition. At the Landusky Mine, the alternatives include free draining pit backfill alternatives, a groundwater drawdown alternative, and a horizontal borehole alternative to prevent water from impounding in the mine pit. Other alternatives have been developed to include additional backfilling to cover the most sulfidic portions of the pit highwalls. And finally, alternatives have been developed that would restore the mine pit topography to near pre-mining conditions in order to address cultural and aesthetic concerns. Mitigation measures have been included in the alternatives to address the potential for increasing contaminants in groundwater from backfill sources that may be acid generating, and to protect revegetation from acid generating materials.

Relocation of Mine Waste Facilities

The removal and relocation of certain mine waste facilities such as waste rock dumps and spent ore heaps were considered during development of the alternatives. Relocation of mine waste can be used to remove the material from close proximity to surface water in streams and drainages, to improve the efficiency of seepage capture systems, and to provide for sources of mine pit backfill. Mine waste relocation was incorporated in the alternatives to represent the range of options required to support pit backfilling and where it would enhance the protection of water quality in the impacted drainages.

At the Zortman Mine, the Alder Gulch waste rock dump, Z85/86 leach pad/dike, and O.K. waste rock dump are the three mine waste facilities considered for relocation. The Z82 leach pad, the Z82 sulfide test heap, the Ruby sulfide stockpile, and portions of the Z85/86 leach pad and the South Ruby dump were backfilled into the O.K. and Mint pits as part of interim reclamation conducted from November 2000 through 2001. Backfilling of this material is common to all alternatives.

Removal of the Alder Gulch waste rock dump at the Zortman Mine was required in the 1998 ROD to provide a source of pit backfill, eliminate a source of contamination to Alder Gulch, reduce water capture system requirements, and ease surface reclamation difficulties on the dump slope. This removal action has been carried forward under some of the reclamation alternatives. Other alternatives would either leave the dump in place or remove only a portion of the dump.

Similarly, removal of the Zortman Mine's Z85/86 leach pad and dike were considered in FEIS Alternative 3, but not adopted by the 1998 ROD due to concerns with placement of cyanidated material off the synthetic liner. The SEIS reconsiders the relocation issue of this mine waste facility with alternatives that range from reclaiming the majority of the spent ore in its present location, to total removal and placement of the spent ore as mine pit backfill.

Alternatives for addressing the O.K. waste rock dump range from complete removal, as in Alternative Z1, to taking no further actions. Regrading the dump in place and using some portion of the dump for backfill are considered under the alternatives.

At the Landusky Mine, materials from seven mine waste facilities are considered for relocation. These include a portion of the Montana Gulch waste rock dump, the L85/86 leach pad and dike, August #1 and #2 waste rock dumps, Gold Bug yellow waste rock dump, part of the L87 leach pad, and a portion of the L91 leach pad. Varying portions of the Montana Gulch waste rock dump would be removed and used as backfill under options that use a notch to provide for drainage from the Landusky Mine pit complex. Removal actions for the L85/86 leach pad vary by alternative; however, all alternatives would remove some material to aid in unblocking the western tributary of the drainage. Some alternatives would completely remove the leach pad and dike for use as pit backfill. A portion of the August #2 waste rock dump at the head of King Creek would be removed under all alternatives to eliminate a source of contamination and to provide pit backfill material. Removal of material from the very large L87 and L91 leach pads would be used to implement the restoration alternatives that require large volumes of backfill. None of the alternatives would totally remove the L87/91 leach pad complex, as all the spent ore would not fit back into the mine pits.

Drainage of the Mine Pits

As noted in Chapter 1, Section 1.5.2, drainage of the mine pits is related to water resource significant issues associated with pit lakes and with re-establishing the hydrologic balance. While the pit drainage issue is of greatest concern at the Landusky Mine, drainage of the Zortman Mine pits are also an issue.

The existing pits at the Zortman Mine have not been excavated deep enough to intercept the groundwater table and therefore do not create permanent pit lakes. However, precipitation and runoff do infiltrate through the pit floors, resulting in a considerable volume of water with ARD contamination reporting to the Ruby Gulch capture system. Backfilling of the Zortman Mine pits to reduce infiltration, limit precipitation from contact with acid-forming minerals, and route runoff out of the pit areas does not require substantial amounts of material compared to the quantity needed at the Landusky Mine pits to achieve a similar result. Because interim reclamation work would establish free draining conditions at the Ross, Mint, O.K./Ruby, North Alabama and South Alabama pits by a combination of backfill and grading, all of the alternatives start from this point. Alternatives considered for additional reclamation of the Zortman Mine pits range from limited backfilling to cover exposed sulfide zones to using a substantial amount of backfilling to re-create the approximate original contour of the mountain. These alternatives were all developed to protect water quality by establishing free draining conditions that would not impound water in the pit areas. The other criteria was to not route runoff from the mine pits northward to the Lodgepole Creek drainage. Since this stream does not appear to be impacted by mine drainage, the risk of creating impacts to an additional stream drainage is not warranted. Moreover, the volume of water that would normally flow in this direction is insignificant. Until the water quality from the pit area runoff can be assured it would not be routed to the north.

The 1998 ROD requirements for pit drainage at the Landusky Mine included cutting a large drainage notch at the south end of the pit complex that would discharge runoff into Montana Gulch. This is a high cost item that would expose additional sulfide minerals in the walls of the drainage notch. Other alternatives have been developed by the technical working group that also would achieve the desired free draining conditions. An artesian well located near the bottom of Montana Gulch has been found to have a direct influence on the water table in the floor of the pits (see Chapter 3, Section 3.3.3). When the well is plugged the water table rises and a shallow pit lake forms at the south end of the pit complex. When the well is open, the pit lake drains and the floor of the pit is dry. Alternatives have been developed to utilize this connection. One of these alternatives is to grade the pit floor to route runoff to the south end of the pit complex where it would infiltrate to groundwater and discharge through the wellhead. Other alternatives have been developed that would provide a directional borehole to further enhance this drainage pathway and serve as a backup in the event the artesian well collapsed or became plugged.

Several alternatives have been developed that involve partial backfilling of the pit to a level that a smaller drainage notch, which would not intersect sulfide minerals, could be constructed. In addition, there are alternatives involving large amounts of backfill, which could route runoff directly as surface flow without the need for a drainage notch or for reliance upon discharge of accumulated pit water via the groundwater system.

Protection/Restoration of Water Quality and Quantity

A major element of all reclamation alternatives is the need to protect area water quality and restore the area streamflows and hydrologic balance. As the contaminant loading analysis shows (see Section 4.3), the protection of water quality relies mostly upon the continued operation of the seepage capture systems and water treatment plants. Contaminant loads reporting to the capture systems would not be dramatically changed by the surface reclamation conducted on the mine waste units. Therefore, the best protection for water quality is realized by assuring the continued operation of the seepage capture and treatment systems. Continued operation and upgrade is provided for these systems under all reclamation alternatives at both mines.

Undoing the preferential groundwater flow paths established by the historic underground mining would be both technically unfeasible and outside the scope of reclaiming disturbance that occurred under the existing mine permits. However, several alternatives have been developed which would address hydrologic balance and the restoration of area water quantity by re-establishing the area topography to the extent that the natural distribution of surface runoff would be restored to pre-mine drainages. Two of the Landusky Mine alternatives incorporate pumping and piping operations to return treated water to the drainage where it was captured to preserve streamflow volume. Most of the Zortman Mine pit reclamation alternatives have the option of being constructed so that the surface runoff could be routed to the north, at a later date, once the water quality was assured. This could compensate for the volume of water presently being diverted to the south by the mine disturbances. Calculations indicate it would require moving a relatively small volume of water to mitigate both the historic disruption in groundwater flow and the current disruption in surface runoff patterns caused by the mine pits (see Section 3.3.3).

Reclamation Grading, Cover Design, and Revegetation

The surface reclamation of mine waste facilities often has to meet multiple and sometimes conflicting objectives. Surface reclamation is desired to be stable and erosion resistant, prevent or limit the infiltration of precipitation which might generate leachate, contain enough soil and nutrients to support a self-sustaining stand of native vegetation, provide for wildlife habitat, and present an aesthetically pleasing environment. Reclamation cover designs, therefore, require consideration of the grading or degree of slope that the reshaped material must achieve, specification on the soil or other material placement and thickness, and plans for revegetation. Since these items are all interrelated, how one is accomplished can affect or dictate the options available for the remaining reclamation items. For example, a steep reclamation slope may be desired to match the pre-mine topography, but may not be stable if covered with a clay or geomembrane (plastic) cover. Or, a thick soil cover needed to hold moisture for vegetation may require new surface disturbance to obtain the soil material, creating its own set of impacts.

The surface reclamation measures considered range from those proposed in the 1998 ROD to those developed by the technical working group. The alternatives vary from the application of a single lift of cover soil to highly engineered barrier cover systems that use synthetic materials. Various reclamation techniques such as the selective use of water barrier and water balance covers dependent upon slope; incorporation of available tailings in the cover soil; soil organic amendments and fertilizers; seed mix; weed control; visual impact mitigation through selective tree planting; and infiltration minimization have all been considered in developing the surface reclamation alternatives.

Restoration of Area Aesthetics and Land Use

The existing mine disturbance has had a significant impact on the aesthetics of the area and, in turn, on some of the land uses. Unreclaimed surfaces are not productive compared to the adjacent undisturbed environment. The visual impacts of the pit areas and other disturbances have had an adverse effect on American Indian traditional uses in the Little Rocky Mountains and on recreationists seeking hiking, hunting, or other outdoor activities.

The alternatives were developed to address these issues by reclaiming disturbed areas to productive conditions comparable to the undisturbed areas. The degree to which restoration of pre-mine conditions is attained would vary by alternative. Generally, the greater the amount of mine pit backfilling, the more restoration to pre-mining topographic conditions is achieved. Even in alternatives where restoration of the pre-mining topography is not achieved, other reclamation activities such as regrading to blend mine disturbance with adjacent landforms; replacement of the soil cover; revegetation techniques; capture and treatment of impacted waters; and re-establishment of wildlife habitat areas are used to address restoration of area aesthetics and land uses.

2.2 DEVELOPMENT of the ALTERNATIVES

In addition to the technical issues discussed above, there are several management issues important to the alternative development process. These include:

- Determining how to best use the available reclamation bonds and water management bonds to reclaim and manage the mine sites should funding be limited to these sources.

- Examining additional reclamation alternatives beyond those affordable under the reclamation bonds to be sure that the best practical reclamation alternative has been considered. This includes identifying and establishing a priority of additional reclamation measures to be implemented should funds become available.

- Continuing to identify reclamation measures common to all alternatives that could be implemented as interim reclamation. Performance of interim reclamation is desirable because it maximizes effective use of the bonds' present value and reduces existing environmental impacts, yet preserves final reclamation options.

Alternative Development Process

Development of the specific reclamation alternatives began with an evaluation of the reclamation plans in the June 1998 ROD. Those 1998 reclamation plans are used in this SEIS as the base case, or "no action" reclamation alternatives (designated Alternative Z1 for the Zortman Mine and Alternative L1 for the

Landusky Mine). While there has been no BLM decision to approve the 1998 reclamation plans due to action by the IBLA, the DEQ's 1998 decision is still in effect. In this particular circumstance the BLM would have to issue a new decision before the existing state-approved reclamation plan could be implemented on BLM-managed lands.

After reviewing the 1998 ROD reclamation plans and considering the issues discussed previously, other alternatives for reclaiming the mines were developed by a technical working group composed of representatives from BLM, DEQ, EPA, and Fort Belknap. The technical working group developed the alternatives using a "Multiple Accounts Analysis" (MAA) process under the direction of Robertson GeoConsultants and Spectrum Engineering. The MAA is an iterative process of considering possible reclamation measures under a central theme, evaluating the effectiveness of the reclamation alternatives, and then revising the alternatives to optimize their effectiveness (see also Section 4.13 and Appendix A).

The technical working group developed reclamation alternatives to address the issues at each mine under several phase 1 and phase 2 scenarios to meet the purpose and need (see Chapter 1). Phase 1 alternative development assumed reclamation expenditures would be limited to that available under the reclamation bonds. Phase 2 reclamation plan alternatives were not constrained by the reclamation bond amounts. While not limited by cost, the development of phase 2 reclamation alternatives did not ignore the need for the reclamation to be financially responsible.

Phase 1 alternative development for the Zortman Mine reclamation considered how to best utilize the existing bond monies under several approaches. One alternative was to reduce the long-term operating and maintenance costs of the water treatment plant by using reclamation bond monies to relocate the treatment plant to Goslin Flats, where captured water could be routed for treatment without pumping (Alternative Z2). The second approach is an alternative that would continue operation of the water treatment plant in its present location and use the available reclamation monies only to conduct regrading and reclamation cover placement, with an emphasis on controlling infiltration that might create leachate requiring water treatment (Alternative Z3).

Reclamation alternatives for the Zortman Mine, developed under phase 2 of the MAA, combined the reclamation strategies minimizing water treatment costs in Alternatives Z2 and source control under Alternative Z3 with plans for additional amounts of pit backfilling as a way to further enhance source control and restore the area topography. This led to the development of Alternative Z4, which includes additional pit backfilling for waste dump removal and application of engineered barrier reclamation covers intended to minimize the need for water treatment. Alternative Z5 was developed to address the issue of restoring the original topography to the extent technically feasible. It incorporates surface reclamation covers similar to the natural soil profile. Alternatives Z4 and Z5 were derived, in part, from the alternative reclamation plan proposal submitted by Fort Belknap at the beginning of the consultation process (Fort Belknap 1999). Alternative Z6 was developed by the technical working group after an initial evaluation of Alternatives Z1 through Z5. Alternative Z6 combines the most environmentally beneficial aspects of Alternative Z4 with Alternative Z3 in order to optimize reclamation performance. This alternative considers using engineered barrier covers in selected areas while providing two feet of growth medium over the majority of the reclaimed area. It provides extensive surface regrading with limited waste dump removal.

The phase 1 alternative development for the Landusky Mine reclamation considered how to best utilize the existing bond monies. Alternative L2, developed under phase 1, optimizes the amount of reclamation earthwork throughout the mine by regrading the ore heaps and waste rock dumps; replacing cover soil and establishing vegetation; providing for pit drainage; and capturing, treating and releasing water impacted by acid drainage. Only a single phase 1 alternative was developed for the Landusky Mine. Relocating the water treatment plant at the Landusky Mine was considered to provide only marginal benefit and did not warrant development of a separate alternative.

Reclamation alternatives for the Landusky Mine, developed under phase 2 of the MAA, were created to incrementally consider the advantages and disadvantages of various amounts of additional mine pit backfill. Within these alternatives are provisions for management of runoff or drainage from the pit area, removal of mine facilities from drainages to improve water management, and an increase in the areas where revegetation can be established. Alternative L3 addresses the issue of reliable drainage from the Landusky Mine pit complex by including the drilling of a directional borehole to provide a backup mechanism for drainage. Alternative L3 also addresses some of the visual impacts by including blasting of the upper bench along a portion of the pit highwall. Alternative L4 increases the amount of pit backfill and unblocks the Montana Gulch drainage to address concerns with water management around the L85/86 leach pad. Alternative L4 also addresses the visual impacts by highwall reduction through blasting and covers about 85% of the exposed sulfide minerals in the highwall that might affect water quality. Alternative L5 addresses the same issues as Alternative L4, but increases the amount of backfill so pit drainage can be achieved without relying on subsurface means and so virtually all exposed sulfides in the mine pit highwalls that might generate acidity and impact water quality can be covered. Alternative L6 would restore the mining area topography to near its pre-mining configuration. It is designed to address the issue of impacts to traditional cultural use of the area, maximize area aesthetics, and restore the surface water drainage configuration. Alternatives L5 and L6 were derived, in part, from the alternative reclamation plan proposal submitted by Fort Belknap at the beginning of the consultation process (Fort Belknap 1999).

How the Alternatives Meet Applicable Requirements

All alternatives were designed by the technical working group to meet the minimum performance standards for mine reclamation and be technically feasible. However, some alternatives pose a greater risk of failure than others, or require more intensive long-term management.

The applicable state and federal reclamation requirements are generally non-quantitative with regard to reclamation elements such as grading, soil cover, revegetation, etc. Requirements are outcome based, calling for reclamation performance to achieve comparable stability and utility, provide an adequate soil cover to support revegetation, minimize erosion, achieve a beneficial use, etc. In this regard, all the alternatives presented in the SEIS would meet these requirements to varying degrees. Some would certainly meet the requirements better or quicker than others, but all would likely be nominally successful.

Where quantitative performance requirements are most evident is in the area of water quality which has specific numeric effluent limits and standards. Under all alternatives (and even under present conditions) the seepage capture and water treatment plants would continue to operate. At present, the effluent discharged from the water treatment plants is meeting the legal numeric requirements. This would continue under the various reclamation alternatives, although some reclamation alternatives would increase the risk of not meeting water quality requirements, such as those involving extensive backfilling of the pits with acid generating spent ore, while other reclamation alternatives would make it easier to meet water quality requirements by keeping acid generating materials on lined areas and covering them with soil to limit infiltration and acid generation. The difference in alternative performance is the degree of difficulty in maintaining compliance with the effluent limits and the impacts of an accidental solution release, or from inefficient seepage capture. However, all alternatives are still feasible in that compliance could theoretically be achieved should the alternative be selected for implementation.

Rationale explaining the basis for the identification of the preferred alternatives has been included in Section 2.6 of this Final SEIS. Additional discussion of how the selected alternatives would satisfy the legal and regulatory requirements will be provided in the Record of Decision.

2.3 ALTERNATIVES ELIMINATED FROM DETAILED ANALYSIS

An alternative to move the Landusky Mine water treatment plant to a lower elevation (similar to Alternative Z2 for the Zortman Mine) was considered and eliminated from detailed analysis. The present location of the Landusky Mine water treatment plant is optimal as it allows most flows from the seepage capture systems to be gravity fed to the plant with minimum pumping. Moving the treatment plant further downhill does not offer any significant environmental or cost benefits. It could actually increase costs if future water capture in the northern drainages is to be returned to those drainages after treatment.

Alternatives which applied reclamation measures only to a single mine facility, to the exclusion of other disturbance areas, were not considered in detail. For example, reclamation plans which only worked on water resource protection or only addressed pit backfilling were not considered in detail as they would not meet minimum regulatory requirements for reclamation of the remaining disturbance areas.

Several modifications to Alternative L5 were considered and eliminated from detailed analysis. One possible alternative was to use “clean” fill from offsite as pit backfill instead of spent ore from the L87/91 leach pad. This was considered as a way to eliminate potential impacts to water resources from backfilling the pit with the leach pad material, which is likely to be acid generating. Preliminary calculations show that to haul in clean fill from within 10 miles would require 378,000 haul truck trips through or near (depending on road routing) the community of Hays, on the Fort Belknap Reservation, and would take an estimated 63 years to complete (Spectrum 2001). It would also increase the estimated cost for Alternative L5 by over 2.5 times, from $68.5 million to $170.8 million. Due to the extreme timeframe required for reclamation completion, the inherent traffic safety hazard, and the potential for severe offsite impacts from haul truck traffic, noise, and dust, this alternative was eliminated from detailed analysis and further consideration.

The second modification considered for Alternative L5 was to amend the backfill from the L87/91 leach pad with agricultural lime in order to neutralize any acidity that develops in the backfill. Estimates indicate it would require approximately 431,500 tons of agricultural lime to amend the backfill as it is placed (Spectrum 2001). This option would cost more than double the estimated amount for Alternative L5, increasing it from $68.5 million to $135.9 million and would probably still fail to adequately protect water quality. Liming is a preventative measure which may provide adequate water quality protection when the materials involved are near neutral or need to be buffered where in contact with growth medium. However, liming does not carry the same level of protection as not placing the material in the pits to begin with. Nor does liming function well to protect water quality when it is used to treat materials that are strongly acid generating as is the case with L87/91 pad spent ore. This is because while neutralization may be achieved (in the sense that the effluent pH is neutral) the neutralizing reaction results in products of its own which may degrade water quality with contaminants such as sulfate and other dissolved solids. Although this leachate would not contain significant amounts of metals such as copper, lead and zinc that are mobile at a low pH, it could very well contain other metals such as arsenic and selenium that are mobile under the alkaline conditions which would exist in the backfill amended with lime. In fact, liming could actually promote the release of arsenic and selenium. Additionally, the life of lime treatment is finite. As the lime neutralizes ARD that is produced within the backfill, the lime is dissolved along preferred flow paths and eventually the ARD is discharged untreated. In addition, placement of the amount of lime that would be needed, 431,500 tons, creates new problems. Approximately 21,600 truckloads of lime would have to be hauled through the town of Landusky, thus generating dust and air quality problems and safety concerns for this residential area. This was considered impractical for similar reasons that making 378,750 truck trips up King Creek was considered impractical. Due to the low feasibility for lime amended backfill to substantially increase the protection of water quality, this alternative was eliminated from detailed analysis and further consideration.

2.4 DESCRIPTION of the ALTERNATIVES

The following Sections 2.4.1 through 2.4.3 describe the reclamation alternatives. Section 2.4.1 presents general reclamation measures such as water management, material testing, and cover design considerations that are common to reclamation at both mines. Section 2.4.2 discusses reclamation that is common to all Zortman Mine reclamation alternatives, followed by a description of each Zortman Mine alternative from Z1 through Z6. Section 2.4.3 discusses reclamation that is common to all Landusky Mine reclamation alternatives, followed by a description of each Landusky Mine alternative from L1 through L6.

The alternatives description and subsequent impact analysis in Chapter 4 are presented for each mine independently of alternatives at the other mine. This is a change from the presentation in the FEIS, where a single alternative described reclamation actions for both mines. The alternative descriptions have been kept separate because the mines are under two separate operating permits, with two separate bond amounts that are non-transferable. Furthermore, agency decisions regarding reclamation plans for each mine are not necessarily linked and may have to be made separately.

2.4.1 Reclamation Common to All Alternatives

There are many common elements for reclamation actions that would occur at both mines under all alternatives. These include:

- Water management, consisting of surface water runoff control, water capture, water treatment, leach pad water land application disposal, and water resources monitoring;
- Reclamation testing and cover determinations for liming soil covers, water balance covers, and water barrier covers;
- Reclamation material sources, consisting of identified non-acid generating materials (NAG), tailings, limestone/dolomite, cover soil, and liners;
- Reclamation of support facilities, including soil stockpiles, access and haul roads, land application areas, and borrow areas;
- Revegetation procedures, including seed mix, planting locations, and soil treatments such as fertilizers or mulch; and,
- Interim reclamation, including reclamation measures done to date that would not be significantly altered under any alternative.

Reclamation measures in these categories are similar across the various alternatives. Any differences are highlighted under the individual alternative descriptions in Sections 2.4.2 and 2.4.3.

Water Management

Under all alternatives, the water management objectives at both mines are to protect beneficial use and to achieve and maintain compliance with the water quality standards. The approach to water management is to use a combination of source control and water treatment to protect water quality. Various reclamation covers would be used in each alternative to limit infiltration of precipitation into mine waste, thereby restricting water contact with potentially acid generating materials. Each of these reclamation covers is discussed in detail under its respective alternative. Source control emphasizes the removal and isolation of acid generating materials from areas proximal to surface and groundwater. The management of mine water would continue to keep mine drainage, stormwater and process waters segregated so that each would be handled using the technology most appropriate to its character. Diversion of runon water that might enter the mine waste would be used to prevent stored acidity from being transported into adjacent surface or groundwaters.

Water Treatment

Capture and treatment of degraded waters would be the primary measures used to prevent residual water quality impacts. Treatment of acid drainage would continue to utilize the existing lime precipitation plants. Biological treatment circuits for removal of selenium and nitrate are under development and may be added to the existing water treatment plants. Passive, semi-passive or semi-active water treatment systems would be constructed in drainage locations where seepage size, rate, composition and drainage geometry show they would have practical application.

Seepage Capture Systems

All seepage capture systems would be upgraded, as needed, in order to improve seepage capture efficiency so that downstream water quality would meet the regulatory requirements at the designated points of compliance in the MPDES permits. Actions associated with improvement of the capture systems could include installation of recovery/monitoring wells, construction of capture ponds, installation of groundwater interception trenches or cutoff walls, and replacement of existing equipment with higher capacity components.

Surface Water Runoff Control

Drainage ditches would be maintained throughout the mining area to route stormwater and runoff around the pit complex, leach pads and waste dumps. All new runon and runoff drainage ditches would be constructed to convey runoff from at least a 6.33-inch, 24-hour storm event. This is the calculated 100-year storm event. Drains carrying stormwater would be routed to dispersion points consisting of coarse rock filters or sediment control ponds that overflow into natural drainages. Maintenance would consist of removal of sediment buildup and repositioning of riprap when necessary.

Berms would be constructed along the upper perimeter of the mine pit highwalls. The berms would divert runoff from the pit areas and provide for a safety barrier.

Leach Pad Water Land Application Disposal

Because the leach pads capture and hold all water falling within their lined perimeters, the accumulation of precipitation stored within these facilities must be managed. Although this leach pad water is not suitable for direct release into streams, it can be applied to the land in a controlled manner which minimizes adverse environmental impacts. Since 1998, a land application and disposal (LAD) facility has been operated to dispose of the leach pad water. The LAD site is located on Goslin Flats, about one mile south of the town of Zortman. The water is conveyed down to the 364-acre LAD site via pipeline. At the facility, it is directed through smaller pipes to various application areas where it is sprayed over the ground by elevated sprinklers. The application areas are managed as pastures that are either grazed or harvested as beneficial agricultural production. The application of the treated process water is designed around the natural capacity of the native soils to attenuate metals. Application rates are adjusted seasonally to match the water consumption by vegetation. A portion of the nutrients in the applied waters are assimilated by the vegetation. Since the nitrogen load exceeds the assimilation capacity, a bio-treatment system has been constructed to treat solution prior to land application. The monitoring program for the LAD area includes monitoring of groundwater, surface water, soils, soil water and vegetation. The location and operation of the land application area is described in detail in the report entitled Goslin Flats Land Application Disposal Expansion Assessment and 2000-2001 Plan of Operations (HSI and Spectrum 2000).

Current conditions require yearly leach pad water draindown at the rate of 125 to 150 million gallons from both mines. The cyanide content in most pad waters has been reduced through natural degradation to low levels relative to the cyanide content present during leaching operations. Leach pad waters would continue to be pumped from the leach pads to the Z82 pond for treatment with hydrogen peroxide to detoxify residual cyanide prior to re-entering the pipeline to Goslin Flats for land application. Alternatively, once the bioreactor is operational it would be used to remove cyanide from the leach pad waters prior to land application. All solutions would be at or below 0.22 mg/l WAD cyanide concentration prior to land application. Leach pad water may also be run through the water treatment plant, if necessary, to reduce the acidity prior to land application.

Testing has been completed on a biological process to remove nitrates, cyanide, and selenium from the leach pad water. The results indicate the nitrate, cyanide and selenium levels can be economically treated to the drinking water standard using naturally occurring microbes. A full-scale biological treatment facility has been constructed and will begin operating in the spring of 2002. Depending on full-scale treatment results, the treated water could be released, routed through a water treatment plant, or sent to the land application area for final treatment and disposal.

The leach pad liners would not be perforated until the leachate in the pads meets water quality standards without treatment. Until that time, maintenance of the pumping systems and treatment of the pad waters would continue using the water treatment plants and land application system.

Water Resources Monitoring

An Interim Groundwater Monitoring Plan was prepared by ZMI in February 1997. In May 1998, a draft Groundwater Monitoring Plan was prepared by the operator in accordance with the requirements specified in Section VII (Paragraph 15) and Appendix C of the Consent Decree; however, ZMI's bankruptcy prevented its completion. The following interim monitoring plan has been conducted since that time.

At the Zortman Mine, routine monitoring under the Consent Decree has included the following number of surface water and groundwater monitoring locations:

Drainage	Surface Water	Groundwater
Ruby Gulch	1	8
Alder Gulch	3	5
Lodgepole Creek	2	6
Goslin Gulch/LAD	10	14

At the Landusky Mine, routine monitoring under the Consent Decree has included the following number of surface water and groundwater monitoring locations:

Drainage	Surface Water	Groundwater
Sullivan Gulch	1	2
Mill Gulch/Rock Creek	1	10
Montana Gulch	2	6
King Creek	1	5
Swift Gulch	3	5

In addition to these monitoring sites, 14 mine drainage monitoring sites and 22 stormwater locations are monitored.

Routine water analysis consists of 6 general parameters, including pH, specific conductance, total dissolved solids (TDS), alkalinity, bicarbonate, and total hardness; 11 anions and cations, including total cyanide; and 11 metals and trace elements. These parameters are specified in Table 3.3.2 of the Interim Monitoring Plan. Other analyses are performed for special purposes as needed.

The interim monitoring plan would continue to be implemented until replaced by a revised monitoring plan that would incorporate requirements from the mine permits, Consent Decree, and MPDES permits. The revised monitoring plan is being prepared by the technical working group for implementation in 2002.

Reclamation Testing and Cover Development

Prior to placement of the surface reclamation covers, all regraded surfaces would be tested to determine acidification potential and to evaluate the need for lime treatment. Lime application rates would be determined by sampling the regraded surface on 100-foot centers or closer, if variations in rock type suggest the need for closer infill sampling. Field pH and TDS measurements of the material fines would be recorded at each sampling point. In addition, samples would be collected for lab analyses of acid potential (AP) and neutralization potential (NP). The net acid potential (Net AP) at each sample point would be calculated from the lab results (Net AP=AP-NP). The amount of lime required to provide long-term neutralization of the mine rock at each sample point on the regraded surface would then be determined. Neutralization values for the areas between sample points would be derived by linear interpolation from the known points. Agricultural lime would be delivered to the site in belly dump trailers. After being dumped in the application area, the lime would be spread by motor grader before being incorporated into the top two feet by a bulldozer equipped with rippers. More details on the liming program are available in Robertson GeoConsultants Report 075001/4 (Robertson 2000a).

A variety of reclamation cover types were considered for use on the regraded surfaces. These range from simple soil covers, to water balance covers designed to maximize evapotranspiration, to the more engineered water barrier covers designed to restrict water infiltration below the barrier layer. Figure 2.4-1 displays the reclamation covers that would be used in the various alternatives for reclamation at the Zortman Mine. Figure 2.4-2 shows the reclamation covers that would be used at the Landusky Mine.

Soil Covers

Soil covers are designed with two primary functions in mind. The first is to provide a suitable substrate for vegetative growth. The second is to minimize infiltration through the cover. The depth of the soil cover would vary somewhat between the alternatives, and between the mine facilities in any one alternative. From 8 to 36 inches of soil would be place over NAG material. The NAG would either be imported from another area of the mine and placed at depths ranging from 0 to 36 inches, or in-situ material would be tested and lime amended as described above. At the Zortman site, tailings could also be used as a source of NAG or as a separate soil layer.

Water Balance Covers

Water balance covers are designed to limit the amount of moisture reaching the waste zone by maximizing evapotranspiration. The cover consisting of soil (12 to 36 inches) and NAG (12 to 24 inches) would provide water storage capacity and would serve as a substrate for vegetative rooting. Water is mostly taken up by vegetation or is lost directly to the atmosphere. A filter fabric would be placed on top of the capillary break (coarse rock drain layer) to limit downward migration of fine-grained particles which could clog the capillary break drainage capacity. A geosynthetic liner would not be used in this reclamation cover because of the decreased potential for surface water infiltration, due in part to the increased water holding capacity and evapotranspiration provided by reclaimed surfaces.

Water Barrier Covers

Water barrier covers limit the downward migration of water into the waste zone by using low permeability materials such as compacted clay, PVC, HDPE or GCL to restrict downward water movement. Water barrier covers would be installed on flat or gently sloping (less than 25%) areas that are determined to be acid generating. Facilities such as backfilled pit surfaces, waste rock facility surfaces, ore processing areas, and some haul roads would be expected to need a water barrier cover. Unlike the water balance cover, the barrier cover would incorporate a geosynthetic liner to provide additional assurance that surface water would not seep into the potentially acid generating material underneath. Infiltration of water is more likely to occur on the gently sloping surfaces where surface water could pond and be less likely to run off.

For this cover, 12 to15 inches of soil, or a composite layer of 8 to 12 inches of soil plus 10 to 12 inches of tailings, would be placed over 24 to 36 inches of NAG. The NAG layer serves as a drain layer should infiltration water accumulate above the geosynthetic liner. It also provides the amount of cover needed to achieve a 3.5- to 4-foot thickness over potentially acid generating areas. Only 12 inches of coarse material is needed to function as a drain layer, and the upper 12 to 24 inches could be constructed with subsoil.

Reclamation Materials

Cover Soil

Soil salvaged during mining and stored in the stockpiles would be used to construct the reclamation covers. Another source of soil is the material salvaged during re-reclamation activities on facilities that have already been soiled and revegetated. Other materials used in reclamation include unconsolidated rock, scree and soil above and below roadway cuts, which are incorporated into the regrading of haul and access roads.

Geosynthetic Liners

Several types of geosynthetic liners may be used in construction of the reclamation covers. A geosynthetic clay liner (GCL) is a combination of a thin bentonite clay layer sandwiched between two geotextile layers. The bentonite provides a seal between the geotextiles. When the bentonite is exposed to moisture it swells, providing added protection against leaks or cracks. HDPE stands for *high density polyethylene*. This is basically a plastic sheeting that is laid in large strips and seamed together. Other similar synthetic materials, such as PVC or hypalon, may be substituted if determined more desirable or cost effective.

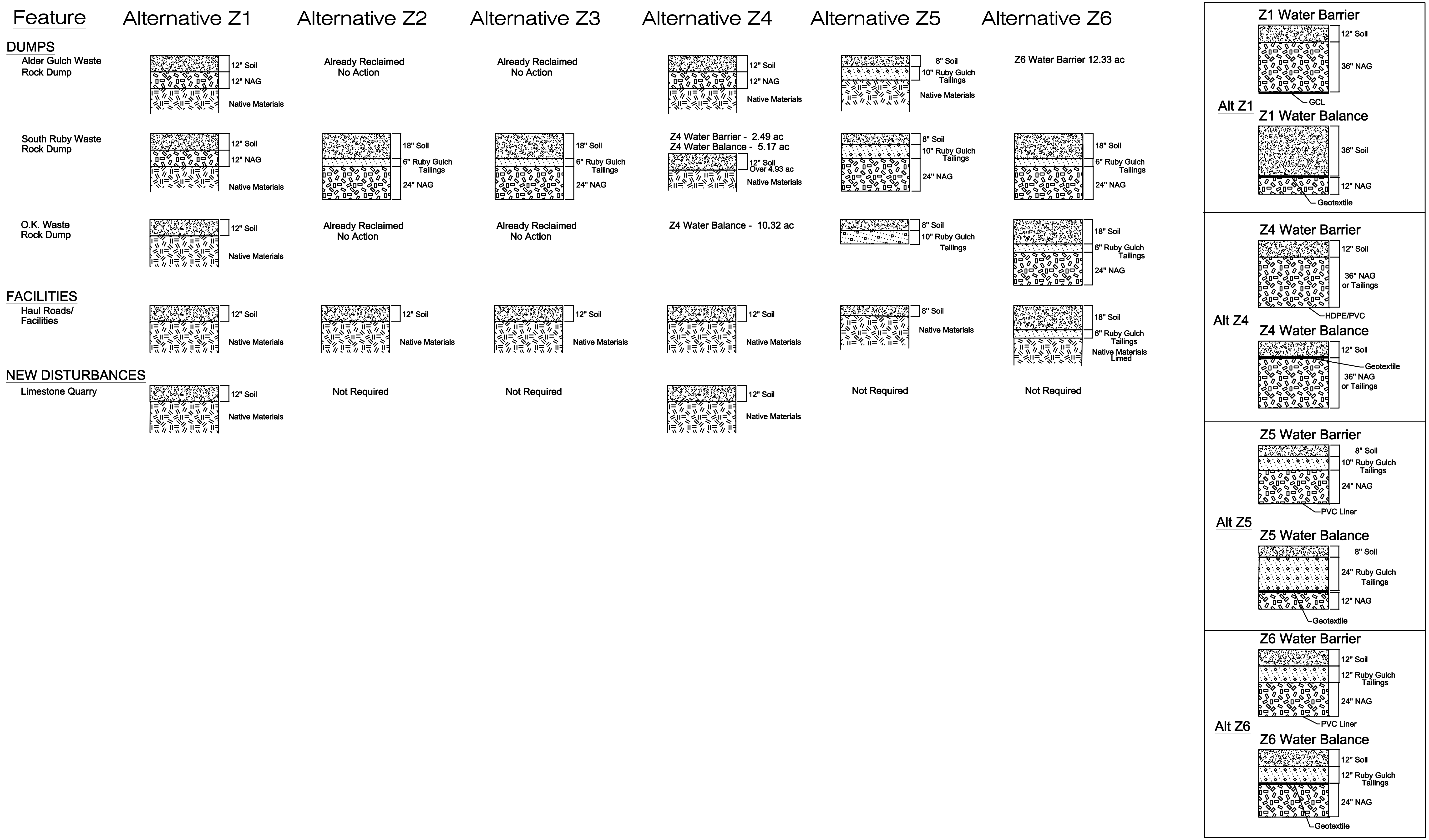
ZORTMAN MINE RECLAMATION COVERS ALTERNATIVES Z1-Z6

Feature	Alternative Z1	Alternative Z2	Alternative Z3	Alternative Z4	Alternative Z5	Alternative Z6
MINE PITS						
O.K./Ruby Pit	Z1 Water Barrier - 5.98 ac Z1 Water Balance - 28.46 ac	Z6 Water Barrier - 22.02 ac	Z6 Water Barrier - 22.02 ac	Z4 Water Barrier - 20.33 ac Z4 Water Balance - 1.10 ac	Z5 Water Barrier - 10.07 ac Z5 Water Balance - 24.65 ac	Z6 Water Barrier - 22.02 ac
Mint Pit	Z1 Water Barrier - 7.67ac	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG	Z4 Water Barrier - 5.85 ac Z4 Water Balance - 4.71 ac	8" Soil 10" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG
North Alabama Pit	Z1 Water Barrier - all	12" Soil Native Materials	12" Soil Native Materials	Z4 Water Barrier - 3.10 ac Z4 Water Balance - 5.38 ac	8" Soil 10" Ruby Gulch Tailings	Z6 Water Barrier - 5.41 ac
South Alabama Pit	Z1 Water Barrier - all	12" Soil 24" NAG	11" Soil 7" Ruby Gulch Tailings 24" NAG	Z4 Water Balance - 17.68 ac	8" Soil 10" Ruby Gulch Tailings	18" Soil 6" Ruby Gulch Tailings 24" NAG
Ross Pit	12" Soil 12" NAG	12" Soil 12" NAG	12" Soil 12" NAG	Z4 Water Barrier - 4.30 ac Z4 Water Balance - 14.61 ac	8" Soil 10" Ruby Gulch Tailings	18" Soil 6" Ruby Gulch Tailings 12"-24" NAG
LEACH PADS						
Z 82 Leach Pad Footprint (Pad placed in OK/Ruby Pit)	12" Soil 12" NAG Native Materials	18" Soil 6" Ruby Gulch Tailings Native Materials Limed	18" Soil 6" Ruby Gulch Tailings Native Materials Limed	18" Soil 6" Ruby Gulch Tailings Native Materials Limed	18" Soil 6" Ruby Gulch Tailings Native Materials Limed	18" Soil 6" Ruby Gulch Tailings Native Materials Limed
Z 85/86 Leach Pad	Z1 Water Barrier - 17.77 ac Z1 Water Balance - 15.22 ac	12" Soil 24" NAG	11" Soil 7" Ruby Gulch Tailings 24" NAG	Z4 Water Barrier - 10.36 ac Z4 Water Balance - 22.99 ac	8" Soil 10" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG
Z 85/86 Drainage Notch	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG
Z 79-81 Leach Pad	Z1 Water Barrier - 4.28 ac Z1 Water Balance - 10.89 ac	More Revegetation	More Revegetation	Z4 Water Barrier - 4.28 ac Z4 Water Balance - 10.89 ac	More Revegetation	More Revegetation
Z 83, 84, 89 Leach Pads	Z1 Water Barrier - 16.66 ac Z1 Water Balance - 24.38 ac	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG	18" Soil 6" Ruby Gulch Tailings 24" NAG
PAD DIKES						
Z 83, 84, 89 Pad Dikes	More Revegetation	More Revegetation	More Revegetation	More Revegetation	More Revegetation	More Revegetation

Alt Z1	Z1 Water Barrier	12" Soil 36" NAG GCL
	Z1 Water Balance	36" Soil 12" NAG Geotextile
Alt Z4	Z4 Water Barrier	12" Soil 36" NAG or Tailings HDPE/PVC
	Z4 Water Balance	12" Soil Geotextile 36" NAG or Tailings
Alt Z5	Z5 Water Barrier	8" Soil 10" Ruby Gulch Tailings 24" NAG PVC Liner
	Z5 Water Balance	8" Soil 24" Ruby Gulch Tailings 12" NAG Geotextile
Alt Z6	Z6 Water Barrier	12" Soil 12" Ruby Gulch Tailings 24" NAG PVC Liner
	Z6 Water Balance	12" Soil 12" Ruby Gulch Tailings 24" NAG Geotextile

SOURCE: Spectrum Engineering 2001

FIGURE 2.4-1a



SOURCE: Spectrum Engineering 2001

ZORTMAN MINE
RECLAMATION COVERS
ALTERNATIVES Z1-Z6

FIGURE 2.4-1b

LANDUSKY MINE RECLAMATION COVERS ALTERNATIVES L1-L6

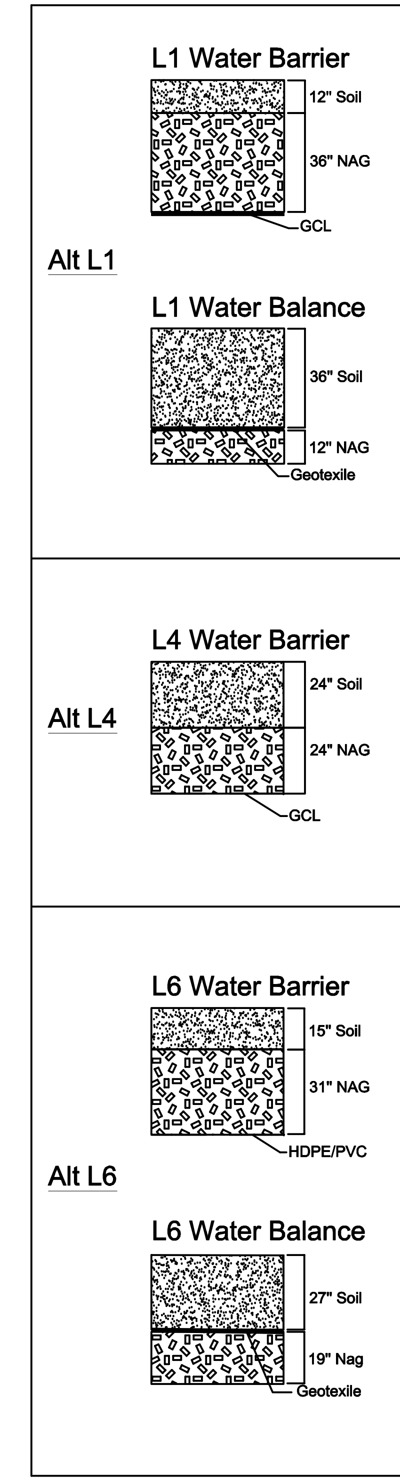
Feature	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5	Alternative L6
PITS						
August-Little Ben Pit	L1 Water Barrier - 35.98 ac 12" Soil 12" Soil / 12" NAG	18" Soil / 6" NAG	18" Soil / 6" NAG 12" Soil	24" Soil / 24" NAG	25" Soil / 21" NAG	L6 Water Barrier - 14.24 ac L6 Water Balance - 151.11 ac
Queen Rose Pit Suprise Pit	L4 Water Barrier - 25.29 ac	L4 Water Barrier - 25.29 ac	L4 Water Barrier - 25.29 ac	L4 Water Barrier - 25.29 ac	25" Soil / 21" NAG L4 Water Barrier on the bottom	(Part of August-Little Ben/Suprise Pit Complex) L4 Water Barrier - 25.29 ac on the bottom
Gold Bug Pit Complex	L1 Water Barrier - 17.72 ac L1 Water Balance - 3.81 ac	24" Soil / 24" NAG	24" Soil / 24" NAG	24" Soil / 24" NAG	25" Soil / 21" NAG	L6 Water Barrier - 11.11 ac L6 Water Balance - 82.45 ac
Gold Bug Highwall Reduction	12" Soil / Native Material	12" Soil / Native Material	12" Soil / Native Material	12" Soil / Native Material	12" Soil / Native Material	(Part of Gold Bug Pit Complex)
LEACH PADS						
L 79 Pad	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation
L 80-82, 83, 84 Pads	L1 Water Barrier - 31.73 ac L1 Water Balance - 38.47 ac	18" Soil / 6" King Cr. Tailings / 24" NAG	18" Soil / 6" King Cr. Tailings / 24" NAG	18" Soil / 6" King Cr. Tailings / 24" NAG	18" Soil / 6" King Cr. Tailings / 24" NAG	18" Soil / 6" King Cr. Tailings / 24" NAG
L 85/86 Pad	L1 Water Barrier - 4.84 ac L1 Water Balance - 22.10 ac	24" Soil / 24" NAG	24" Soil / 24" NAG	24" Soil / Native Material Limed	12" Soil / Native Material	12" Soil / Native Material
L 87-91 Pad Complex	L1 Water Barrier - 65.10 ac L1 Water Balance - 138.54 ac	24" Soil / 15" NAG	24" Soil / 15" NAG	24" Soil / 24" NAG	25" Soil / 21" NAG	L6 Water Barrier - 144.64 ac L6 Water Balance - 59.42 ac
PAD DIKES						
L 85-86 Dike	L1 Water Balance - 3.04 ac	24" Soil / 24" NAG	24" Soil / 24" NAG	(See 85/86 Leach Pad - Total Removal)	(See 85/86 Leach Pad - Total Removal)	(See 85/86 Leach Pad - Total Removal)
L 83 Dike	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation
L 91 Dike	L1 Water Barrier - 1.62 ac L1 Water Balance - 17.50 ac	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation
DUMPS						
Montana Gulch Waste Rock Dump (Part not already reclaimed)	L1 Water Barrier - 13.43 ac	24" Soil / 15" NAG	24" Soil / 15" NAG	24" Soil / 24" NAG	25" Soil / 21" NAG	L6 Water Barrier - 7.04 ac

	Cover	Layers
Alt L1	L1 Water Barrier	12" Soil / 36" NAG / GCL
	L1 Water Balance	36" Soil / 12" NAG / Geotextile
Alt L4	L4 Water Barrier	24" Soil / 24" NAG / GCL
Alt L6	L6 Water Barrier	15" Soil / 31" NAG / HDPE/PVC
	L6 Water Balance	27" Soil / 19" Nag / Geotexile

SOURCE: Spectrum Engineering 2001

FIGURE 2.4-2a

Feature	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5	Alternative L6
DUMPS CONT.						
Montana Gulch Topsoil Stockpile	12" Soil	12" Soil	12" Soil	12" Soil	12" Soil	12" Soil
August #1 Waste Rock Dump	12" Soil 24" NAG Limed	24" Soil 24" NAG Limed	24" Soil 24" NAG Limed	24" Soil 24" NAG Limed	24" Soil 24" NAG Limed	(See August-Little Ben/Suprise Pit Complex)
August #2 Waste Rock Dump (East Lobe)	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material
August #2 Waste Rock Dump (West Lobe)	Already Reclaimed No Action	Already Reclaimed No Action	Already Reclaimed No Action	Already Reclaimed No Action	Already Reclaimed No Action	12" Soil Native Material
Gold Bug Yellow Waste Rock Repository	L1 Water Barrier - 9.38 ac L1 Water Balance - 3.73 ac	24" Soil 24" NAG	24" Soil 24" NAG	24" Soil 24" NAG	25" Soil 21" NAG	(Part of Gold Bug Pit Complex)
Upper Gold Bug Blue Waste Stockpile	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	(Part of Gold Bug Pit Complex)
Lower Gold Bug Blue Waste Stockpile	Native Material	24" Soil Native Material	24" Soil Native Material	24" Soil Native Material	24" Soil Native Material	24" Soil Native Material
South Gold Bug Limestone Stockpile/Pit	L1 Water Barrier - 5.24 ac L1 Water Balance - 2.28 ac 12" Soil 12" NAG	24" Soil 24" NAG	24" Soil 24" NAG	24" Soil 24" NAG	25" Soil 21" NAG	(Part of Gold Bug Pit Complex)
Gold Bug Topsoil Stockpile	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material
Mill Gulch Waste Rock Dump	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation
FACILITIES/OTHER						
Haul Roads/Facilities	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material	12" Soil Native Material
Big Horn Ramp	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation	Additional Revegetation
NEW DISTURBANCES						
Limestone Quarries	12" Soil Native Material	Not Required	Not Required	Not Required	Not Required	Not Required
West Montana Gulch Drain (Around 85/86 Pad)	12" Soil Native Material	Not Required - Partial Notch Only	Rock Cliff - Too Steep to Reclaim	Not Required (85/86 Leach Pad and Dike have been Removed)	Not Required (85/86 Leach Pad and Dike have been Removed)	Not Required (85/86 Leach Pad and Dike have been Removed)



SOURCE: Spectrum Engineering 2001

LANDUSKY MINE RECLAMATION COVERS ALTERNATIVES L1-L6

FIGURE 2.4-2b

Support Facilities Reclamation

Final reclamation of the mine includes the removal of structures and equipment used in the mining and processing of ore.

Access and Haul Road Reclamation

Haul roads would be ripped to reduce compaction, reshaped to approximate original contour, tested to determine their acid generating potential, limed where necessary, covered with soil, and revegetated. Roadway berms and loose, unconsolidated material above and below the roadway cut would be pulled or dozed into the roadway using a dozer or backhoe. Some haul roads may also be left to function as post-reclamation access roads, though with a reduction in the width of the running surface.

All alternatives would leave a post-reclamation access road between the Zortman and Landusky Mines over Antoine Butte. The communication sites on Antoine Butte would continue to be accessible by vehicle from the towns of either Zortman or Landusky. Roads would also be left to provide access to each mine's water treatment plants and the seepage capture systems. The access road from the Landusky Mine to the community of Hays would remain in place.

While the post-reclamation access roads described above would all remain in place, their use may be restricted to authorized personnel only, in order to protect the reclaimed areas, water treatment plants, and communication facilities from theft, damage or vandalism.

Land Application Area Reclamation

Reclamation of the Goslin Flats land application area would include removal of irrigation equipment and pipelines, regrading of roadways, any necessary amendment of the area soils, and revegetation of disturbed surfaces.

Revegetation Procedures

Areas disturbed by mine operations would be revegetated to stabilize soil and slopes, re-establish plant communities ecologically comparable to pre-mine conditions, maximize water use, and restore watershed, wildlife, recreational, and aesthetic values that meet post-operation land use objectives. Trees would be used in revegetation on a limited basis for visual impact mitigation and to enhance water use. Grasses, forbs, and shrubs would be used to enhance wildlife habitat. Shrubs would also enhance water use. Plant species selected for revegetation would be based on species occurrence within the project area, land use objectives, presence of the species on pre-mine disturbances, establishment potential, growth characteristics, soil adaptation and stabilizing qualities, wildlife palatability, water consumption and availability (See also Section 4.5, Vegetation and Revegetation). Revegetation procedures would also include the amendment and cultivation of substrates to support healthy plant communities. After planting and seeding, supplementary fertilization would be used until self-sustaining vegetation is established. These considerations are components of the revegetation plan, *Revegetation Investigation and Revegetation Prescriptions for Zortman-Landusky Mine Sites* (Bighorn Environmental Sciences 2000).

Interim Reclamation

Interim reclamation work has been ongoing since 1999. This is reclamation work that the agencies and interested parties agreed would not prejudice the selection of a final reclamation alternative and should proceed in order to begin remediation of existing mine impacts. This reclamation work is presently scheduled to continue into 2002.

2.4.2 Zortman Mine Reclamation Alternatives

Section 2.4.2 presents a description of the six reclamation alternatives developed for the Zortman Mine. Although the alternatives vary in emphasizing certain aspects of reclamation, all alternatives were formulated by the agencies' engineering consultants, under the direction of the technical working group, to meet the applicable regulatory requirements and standards for mine reclamation. The major difference between the Zortman Mine reclamation alternatives is the amount of pit backfill placed in the North and South Alabama, Ross, O.K./Ruby and Mint pits. The amount of backfilling dictates how much dump and leach pad material would be picked up and placed back into the pits.

Alternative Z1 is basically the reclamation plan initially selected in the agencies' June 1998 Record of Decision, and is based on Alternative 3 from the FEIS. It has been modified slightly to account for the interim reclamation that has been completed to date.

Alternative Z2 is designed to be affordable within the current reclamation bond amount and to optimize the long-term economics of the water treatment plant operation. The funding would first be used to relocate the water treatment plant to Goslin Flats. The remainder would be used to regrade, topsoil, and revegetate the mine disturbance.

Alternative Z3 is also designed to be affordable within the current reclamation bond amounts. The water treatment plant would be left where it is currently located. The reclamation funds would be used to place a greater thickness of growth medium over all regraded surfaces to further limit water contact with acid generating materials. The additional growth medium would be obtained from the tailings stockpiles.

Alternative Z4 is not restricted by the reclamation bond amounts. The earthwork portion of the alternative includes removal of the Alder Gulch waste rock dump and backfilling the upper pits to cover the majority of sulfide minerals exposed in the pit highwalls. Additional regrading of the leach pads would be conducted and all potentially acid generating materials would be covered with water barrier or water balance reclamation covers.

Alternative Z5 is also not restricted by the reclamation bond amounts. The mine pits would be backfilled using material from the waste rock dumps and portions of the leach pads in order to restore the approximate pre-mine topography. Only the O.K./Ruby pit backfill would be covered with water barrier or water balance reclamation covers.

Alternative Z6 is the "Preferred Alternative." It is not restricted by the reclamation bond amount. The water treatment plant would be left where it is currently located. The earthwork portion of the alternative would provide for partial relocation of the Alder Gulch waste rock dump to the North Alabama pit, covering exposed sulfides in the Ross pit, and additional regrading. The use of geosynthetic liners would be limited to the O.K./Ruby pit backfill, Alder Gulch waste rock dump, and North Alabama pit backfill. A 24-inch thick soil/tailings cover would be placed over the majority of the reclaimed area.

Reclamation Common Among Zortman Mine Alternatives

Water Management

This section presents an overview of water management plans for the Zortman Mine that would be used under all alternatives to mitigate water quality impacts from mine facility discharges. It includes a description of measures that would continue to be implemented for management of process waters, stormwaters and mine drainage. This section is divided into discussions on surface water runoff control, water capture, water treatment, land application disposal, and monitoring.

Surface Water Runoff Control

All Zortman Mine pits would be backfilled and graded to prevent impoundment of runoff in pit areas. Currently, water which infiltrates through the mine pit floor enters the groundwater system and resurfaces in Ruby Gulch considerably degraded. This water management approach would restrict precipitation from infiltrating the pit floor and instead route the runoff into Ruby Gulch as surface water.

Water Capture

The water capture structures in Ruby Gulch, Alder Spur and Carter Gulch would remain in place as long as needed to capture seepage that would impact water quality. When no longer needed, the water capture structures would be dismantled and removed, and the disturbance area would be regraded and revegetated.

Water Treatment

ZMI constructed a water treatment plant at the Zortman Mine in May 1994 to treat acidic seepage captured at the base of the leach pad dikes and Alder Gulch waste rock dump. The plant operates at a rate of 200 to 800 gallons per minute approximately 8 days per month, depending on factors such as precipitation amounts and seasonal operating conditions. Interim effluent discharge standards from the plant are required to meet the Consent Decree standards. Establishment of final effluent limits and outfall points would occur as part of MPDES permit development (Appendix C). The Zortman Mine water treatment plant would continue to operate indefinitely, although it would be relocated to Goslin Flats under Alternatives Z2, Z4 and Z5.

Acidic seepage captured at the base of the mine facilities is pumped back to a pond prior to entering the water treatment plant. This feed pond has a 4,786,000 gallon capacity. Water is pumped from the feed pond into the water treatment plant. The plant's metal precipitation process uses hydrated lime. Water is pumped through two reaction tanks, a flocculation tank, and a clarifier. Lime is added to the first reaction tank, ferric sulfate is added to the second reaction tank, and a polymer, Allied Colloids Percol E-10 is added to the flocculation tank. Ferric sulfate is added at 1000 to 1300 ml/minute and Percol E-10 is added at 3000 to 4000 ml/min. The thickener provides 8 to 10 hours of detention time. The lime is stored in 50 and 25 ton lime storage silos at the site. The pH set point varies between 7.58 and 8.4. The treated water is discharged to Ruby Gulch.

Leach Pad Water Land Application Treatment

All leach pad draindown water at the Zortman Mine would be treated when necessary to remove residual cyanide, reduce acidity, and remove metals and nitrates prior to being piped to Goslin Flats for final treatment and disposal via land application.

Water Resources Monitoring

The interim monitoring program for groundwater and surface water would continue until replaced by the MPDES permit (Appendix C). A monitoring program containing the combined requirements from the Consent Decree, MPDES permit and the mine operating permits is under development.

Reclamation Materials

A variety of materials would be used in the construction and installation of the reclamation covers and drainage ditches. The primary reclamation materials to be used are cover soil, stockpiled non-acid generating waste rock, non-acid generating spent ore or materials amended with lime to neutralize acidity, limestone quarried on site, and the Ruby Gulch tailings. In addition, certain synthetic materials such as a geosynthetic clay liner or a geomembrane liner would be used in the construction of the water barrier component of the reclamation covers.

Cover Soil

There are presently 185,400 cubic yards of soil stockpiled at the Zortman Mine. Excess cover soil stockpiled at the Landusky Mine could be used to supplement the limited supply at Zortman.

Support Facilities Reclamation

Final mine reclamation would include the removal of all structures and equipment used in mining and processing of ore. At the Zortman Mine this includes the Zortman guard shack and gate, Degerstrom shop, refinery, and the Merrill Crowe plant. Remaining facilities associated with water management include the water treatment plant, Z82 pond, barren pond, Ruby capture pond and Ruby Gulch pumpback, sludge pit, Zortman backup generator, Carter Gulch seepage capture system, and Alder Spur seepage capture system. All water management structures would be left intact in alternatives where the water treatment plant stays at the mine site. In alternatives where the water treatment plant is moved to Goslin Flats, the footprint of the removed facilities would be covered with soil and revegetated.

Zortman Mine Interim Reclamation

Interim reclamation work at the Zortman Mine includes regrading, placement of cover soil and planting the Z83, Z84, and Z89 leach pads; partial backfill of the Ross pit; backfilling the O.K./Ruby and Mint pits; regrading the north half of the Z85/86 leach pad; highwall reduction along the west side of the South Alabama pit; capping the barren pond; and various reclamation actions on the Z82 leach pad, Z82 sulfide stockpile, Ruby sulfide stockpile, South Ruby waste rock dump, South Ruby Saddle soil stockpile, Z82 soil stockpile, and Ruby Gulch West tailings stockpile.

The Z82 sulfide stockpile and Ruby sulfide stockpile have been placed in the bottom of the O.K. pit, capped with 8 inches of clay, and then covered with 60 to 70 feet of backfill. The Z82 leach pad, South Ruby waste rock dump, and a portion of the Z85/86 leach pad have been backfilled into the O.K./Ruby pit complex and the Mint pit. This work leaves three pits (O.K./Ruby and Mint) backfilled to a free draining condition. Two small sources of the worst acid generating sources (Z82 sulfide stockpile and the Ruby sulfide stockpile) along with the Z82 leach pad have been buried in their original source areas south of the groundwater drainage divide, and capped to limit infiltration of surface water.

The pit backfill project includes regrading the north half of the Z85/86 leach pad to route runoff around the north edge of the site into an undisturbed draw to the east. In order to make this runoff discharge into Ruby Gulch, a 42,000 cubic-yard notch has been be cut through the saddle at the head of the draw.

Regrading the Z83, Z84, and Z89 leach pads to 3H:1V slopes was completed in 2000. All surfaces have been tested for acid generation on a 100-foot grid spacing. Any areas not meeting the NAG criteria have been lime treated to ensure that 24 inches of NAG covers the entire leach pad surface. Once limed, Ruby Gulch tailings from the West tailings stockpile were placed on the graded leach pads to a depth of 6 inches. Soil from the South Ruby Saddle soil stockpile and the Z82 soil stockpile was then placed to a depth of 18 inches. The entire surface area of these three leach pads has 24 inches of NAG, 6 inches of tailings, and 18 inches of soil, for a total depth of 48 inches of suitable plant growth medium. All areas were then reseeded with the general grass-forb seed mix listed in Section 4.5.1. The only area of the regraded leach pads left unreclaimed at this time is the sludge pit on the Z89 leach pad, which is needed for disposal of sludge from operation of the water treatment plant.

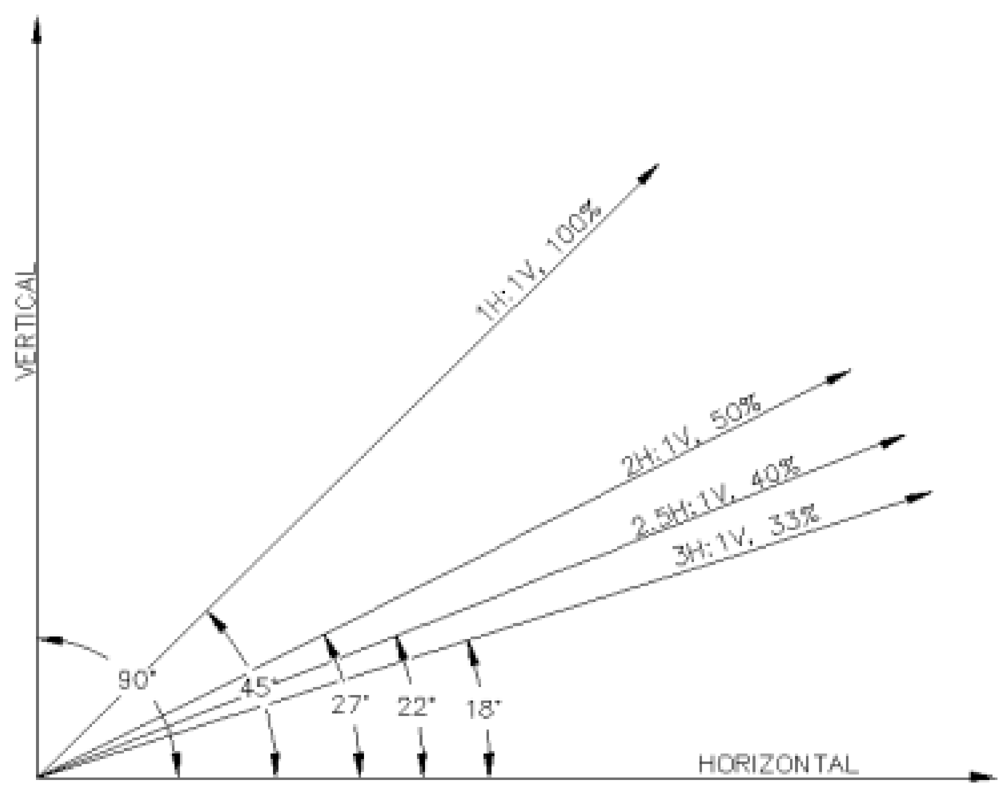
During 2002, the highwall along the west side of the South Alabama pit would be reduced by up to 70 feet. Because this highwall extends up to the top of the ridge, highwall reduction would lower the ridge line. Most of the work would be accomplished by drill and blasting the rock along the top of the highwall and then using bulldozers to push the shot material into the pit. Additional material would be borrowed from an area to the north of the pit to complete backfilling on the pit floor and to cover a sulfide zone in the pit wall on the east side of the pit.

Cleanup and removal of old mining equipment and debris took place during 2000. The timing for removal of support facilities such as maintenance sheds, roads, powerlines, etc. would vary by alternative.

The barren pond is to be reclaimed in 2002. The sludge which has accumulated in this pond would first be mixed with spent ore from the Z85/86 leach pad. Then the pond and the bench on which it is located would be backfilled with additional material borrowed from the Z85/86 leach pad.

In 1999, the floor and accessible benches in the Ross pit were graded. A channel was cut to direct runoff toward the Ruby Gulch drainage. The flat pit bench was amended with lime to prevent acid generation. Additional interim work in 2002 would cover a portion of the sulfide-bearing highwall and a lower sulfide bench with 133,000 cubic-yards of non-acid generating material borrowed from the disturbed area between the North and South Alabama pits. This backfill would be left as a steep rubble slope extending from the pit floor up to a benched area about halfway up the highwall.

The following diagram shows the relationship between reclamation slopes, grades, and the angle from the horizontal. This diagram is useful when reading the alternative descriptions. Reclamation slopes are commonly described as a ratio of the horizontal measurement to the vertical measurement, expressed as H:V. For example, a slope described as 2H:1V, would change by 1 foot in elevation every 2 feet of horizontal distance.



Alternative Z1, 1998 ROD Reclamation

Alternative Z1 would implement the reclamation described under Alternative 3 of the FEIS, as modified by the June 1998 ROD. This alternative has been re-costed with revised unit costs and with bond money set aside for leach pad water management. The reclamation costs for this alternative would exceed the existing reclamation bond amount. The three major cost items include placement of geosynthetic liner and geotextile as part of the respective water barrier or water balance reclamation covers, removal of the Alder Gulch waste rock dump, and leach pad water management. See Section 4.12 for a description of the reclamation costs. The reclamation action for each mine feature is shown in Figure 2.4-3. Those mine features that would be considered reclaimed, and not receiving additional reclamation work under this alternative, are marked "No Action."

Mine Pit Reclamation

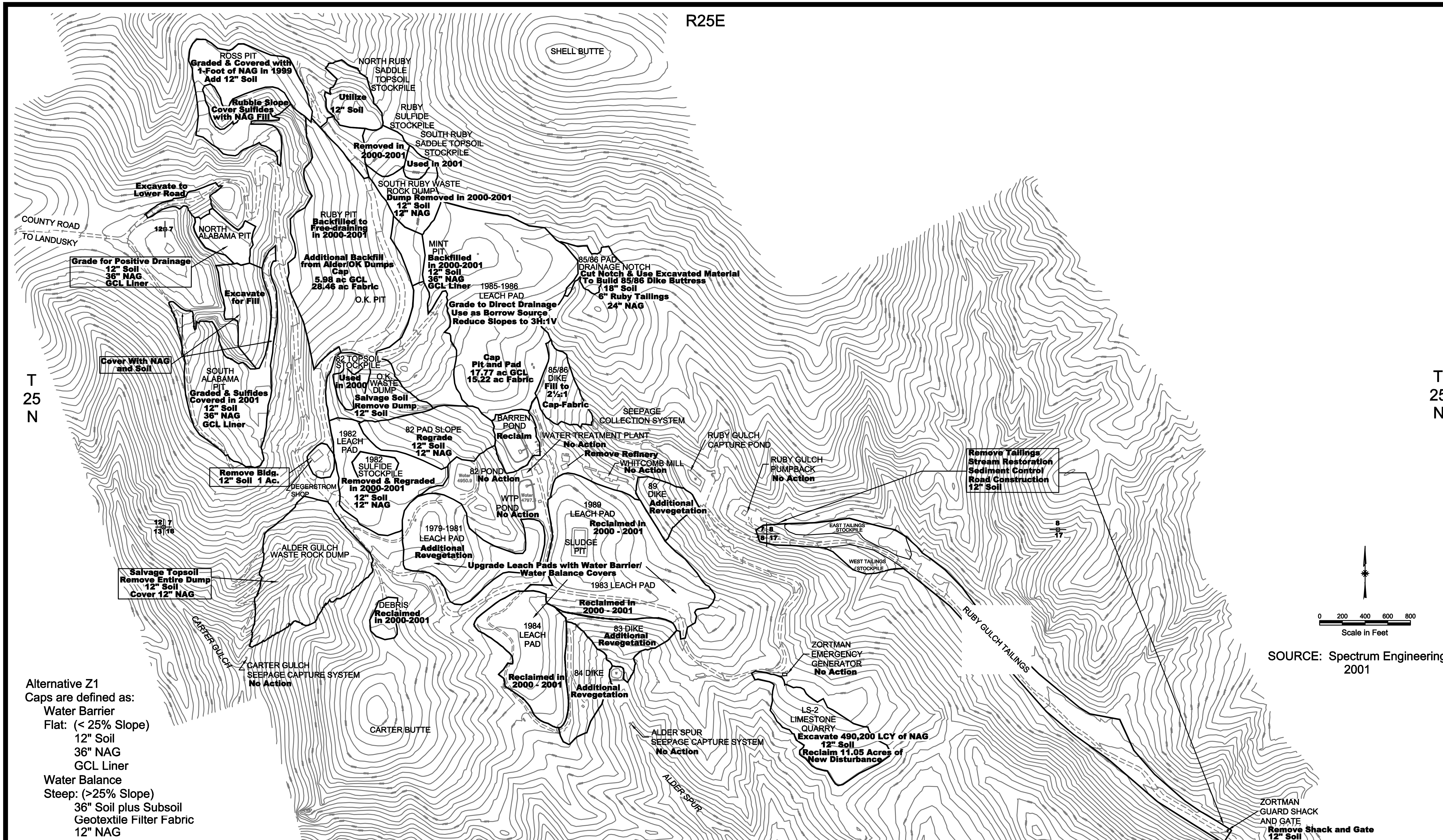
In the initial phase of operations at the Zortman Mine there were six distinct pits. These were the North Alabama, South Alabama, Ross, O.K., Ruby, and Mint pits. By late 1985, continued mining activity had combined the O.K. and Ruby pits into a single pit complex (see also, aerial photos in 1995 Draft EIS, Appendix D).

<u>North Alabama and South Alabama Pits</u>

The North and South Alabama pits are located at the head of the Ruby Gulch drainage. The pit complex stretches for 2200 feet along the ridge between the Ruby Gulch and Carter Gulch drainages. The North Alabama pit was mined down to an elevation of 5370 feet above mean sea level (amsl), while the South Alabama pit was mined to 5230 feet amsl. A long, wide bench with a floor elevation of 5440 feet amsl was mined between the two pits. Along the entire west side of the complex, the pit highwalls extend up to the crest of the ridge. On the east side, there are either low walls or the benches break out along the east-facing slope of Ruby Gulch.

The north wall of the North Alabama pit was mined up to a saddle on the divide between the Ruby Gulch and Lodgepole Creek drainages. The pit highwalls reach to elevations of 5485 feet and 5610 feet, respectively, on the northeast and northwest sides of the saddle. There are no exposed sulfides in the North Alabama pit.

The central bench between the North and South Alabama pits has a 90-foot highwall on its west side and daylights into Ruby Gulch along its east side. Because the topography rapidly increases to the north, the walls at the south end of the South Alabama pit are minimal, yet the pit wall at the north end of the pit reaches nearly 350 feet high. Near the center, the pit highwall is 200 feet high along the ridge on the west side and is less than 80 feet high along the low wall on the east side. Sulfide minerals are exposed in some areas near the bottom of the South Alabama pit.



ALTERNATIVE Z1: RECLAMATION PERFORMED IN ACCORDANCE WITH THE 1996 FINAL EIS, ALTERNATIVE 3 AND 1998 RECORD OF DECISION.

ZORTMAN MINE
ALTERNATIVE Z1

FIGURE 2.4-3

Reclamation at the South Alabama pit would include highwall reduction and pit backfilling to cover the exposed sulfide zones and to make the pit floor free draining. This work would cover most of the pit area with NAG-quality material leaving only a few sections of highwall at the north end on the pit exposed. Some additional backfilling and grading would be required to moderate the slopes for installation of water balance and water barrier reclamation covers. Water barrier covers would incorporate a GCL liner and 36 inches of NAG.

Earthwork on the North Alabama pit would consist of lowering the north rim of the pit and grading the pit floor. The central bench area and haul road would be covered with 12 inches of NAG and 12 inches of soil. The pit floor at the North Alabama would be covered with a GCL liner, 36 inches of NAG, and revegetated. Upon completion of reclamation, all of the highwalls associated with the North Alabama pit (about 220 vertical feet) would still be exposed. These highwalls stand at approximately 45 degrees (1H:1V).

Ross Pit

The Ross pit is situated on a small ridge between two draws on the south side of the Lodgepole Creek drainage. Its uppermost benches extend up to the top of the divide between the Ruby Gulch and the Lodgepole Creek drainages. The Ross pit faces to the north with its highwall extending up to the road on the north edge of the North Alabama pit. The Ross pit was not mined as a pit but was developed by mining along the contour. In this way, the nose of the ridge was pushed back between 600 and 800 feet, leaving a 450-by-600-foot bottom bench at an elevation of 5110 feet amsl. A highwall with multiple benches extends up to an elevation of 5450 feet amsl. These highwalls stand at approximately 45 degrees (1H:1V).

The Ross pit area was partially regraded in 1999 and the flat pit bench was amended with lime to prevent acid generation. Additional interim work would cover a portion of the sulfide-bearing highwall and a lower sulfide bench with non-acid generating material. The backfill placed over the highwall would be left as steep rubble slope. The regraded areas would be covered with12 inches of soil and revegetated. Upon completion of reclamation about 200 vertical feet of highwall would be exposed.

O.K./Ruby and Mint Pits

The O.K./Ruby and Mint pits are both located on an east-facing slope near the head of Ruby Gulch. They are situated below and to the east of the North Alabama pit. The northern end of the O.K./Ruby pit walls extend to the Ross pit. The haul road from the Ross pit travels along the edge of the O.K./Ruby pit. The Mint pit is located to the east of and below the haul road.

The Mint pit is a small pit developed near the head of the drainage. Before being backfilled as part of the Zortman Pit Backfill Project in 2000-2001, it was less than 250 feet wide and around 700 feet long. The pit floor was at an elevation of 4860 feet amsl. The northern portion of the Z85/86 leach pad is located east of the Mint pit. The toe of the South Ruby waste rock dump had encroached into the northwest corner of the Mint pit.

The O.K./Ruby pit was mined along the contour of the hillside for a length of 2300 feet before the open pit was developed. The open pit is 1500 feet long from north to south and has a maximum width of 700 feet. It was mined to a bottom elevation of 4850 feet amsl in two separate sections of the pit. Because the topography rises from south to north, the highwall running along the west side extends up to an elevation of 5200 feet amsl at the south end and to 5350 feet amsl at the north end. The low wall on the east side of the pit sat at about 4975 feet amsl at the south corner, then climbed up to 5070 feet at the north end. Sulfides were exposed at the bottom of the pit and extend part of the way up the west highwall. Remnants of the old drifts and stopes from the underground workings are still visible in the highwalls. The bottom of the pit was blasted as part of interim reclamation to fill other underground openings which were evident in the bottom of the pit.

The O.K./Ruby and Mint pits were backfilled to a free draining condition under interim reclamation. Material from the worst acid generating sources, including the Z82 leach pad, Z82 sulfide stockpile, Ruby sulfide stockpile, and the South Ruby waste rock dump were used as backfill. The two sulfide stockpiles were placed into the O.K. pit, compacted, and covered with a 6-inch layer of clay obtained from the test heap on top of the Z82 leach pad. The Z82 leach pad and Ruby waste rock dump were then placed in the bottom of the O.K./Ruby and Mint pits, thereby adding another 60 to 70 feet of fill over the sulfides. Another 22,000 cubic yards of clay salvaged from the Z82 leach pad was used to cap the entire O.K./Ruby backfill area with 8 inches of clay. The clay was then covered with a PVC liner and 24 inches of NAG. Completion of the Zortman Pit Backfill Interim Reclamation Project in 2001 left the three pits (O.K./Ruby and Mint) backfilled to a free draining condition.

Additional reclamation of the O.K./Ruby and Mint pits would include backfilling the pits with material from the Alder Gulch waste rock dump and the O.K. waste rock dump. The additional fill would create an overall 3H:1V slope which would cover most of the pit highwalls.

All backfilled pit surfaces would be covered with a water barrier or water balance reclamation cover. In order to obtain the amount of NAG material needed, an 11-acre limestone borrow area would be developed at the LS-2 site above the town of Zortman (Figure 2.4-3).

Leach Pad Reclamation

There are six leach pads at the Zortman Mine. These include the Z79-81, Z82, Z83, Z84, Z85/86 and Z89 leach pads. The Z79-81 and Z82 pads are free draining into ponds. The other pads have buttresses or dikes associated with them to impound the leaching solutions. Five of these leach pads have already been graded as part of interim reclamation.

Z79-81 Leach Pad

The Z79 and Z80-81 leach pads were constructed adjacent one another in one pad complex. This leach pad complex covers an area of 15.18 acres on the north side of the Zortman-to-Landusky main access road. It is located almost due south of the water treatment plant and due west of the Z83 and Z89 leach pads. A total of 1,170,900 cubic yards of spent ore is contained on these leach pads.

The Z79 leach pad has been regraded and covered with 8 to 12 inches of soil. Grass was planted in 1989 and trees were planted in 1990. The Z80-81 leach pad was covered with 8 to 12 inches of soil with grass planted in 1991. Trees were planted in 1992. Further reclamation would be conducted on this leach pad complex to install the water barrier or water balance reclamation covers described in the 1998 ROD.

Z82 Leach Pad

The Z82 leach pad covered an area of 10.68 acres and contained approximately 1,154,400 cubic yards of spent ore. The pad was located due south of the O.K. waste rock dump and northwest of the Z79-81 leach pad complex. This leach pad was placed as backfill into the O.K./Ruby pit as part of the Zortman Pit Backfill Interim Reclamation Project. The leach pad footprint would be graded for positive drainage.

Originally, under Alternative 3 of the FEIS the Z82 leach pad would not have been moved but would have been regraded in place with maximum 3H:1V slopes. The surface would have been reclaimed with a water barrier cap or water balance reclamation cover, and revegetated. Since the material has already been backfilled, Alternative Z1 would leave it in the pit and reclaim the leach pad footprint and the slope extending down from its north side with 12 inches of NAG and 12 inches of soil.

Z83, Z84, and Z89 Leach Pads

The Z83, Z84, and Z89 leach pads are the three southernmost pads. The main access road between the Zortman and Landusky Mines goes through the middle of these leach pads. The Z83 leach pad covers an area of 12.89 acres and contains 1,227,100 cubic yards of spent ore. The Z84 leach pad covers 14.2 acres and has 1,489,900 cubic yards of spent ore. The Z89 leach pad covers 14.21 acres and contains 2,174,300 cubic yards of spent ore. The three pads are immediately adjacent one another.

The retaining dikes associated with these leach pads have already been graded, covered with soil and seeded. The 6.02-acre Z83 dike was covered with 8 to 12 inches of soil and revegetated in 1992. The Z84 dike, occupying 6.73 acres, was covered with 8 to 12 inches of soil and revegetated in 1992. The Z89 dike, covering 3.87 acres, was covered with 8 to 12 inches of soil and revegetated with grass and trees between 1989 and 1990. Additional planting and fertilization would be conducted to enhance the existing vegetation on these dikes.

Interim reclamation during 1999 and 2000 included regrading the Z83, Z84 and Z89 leach pads to 3H:1V slopes. The regraded surface was sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Areas with a net acid potential were neutralized with lime. After liming, 6 inches of Ruby Gulch tailings were placed as cover material, followed by 18 inches of soil. All surfaces were seeded in December 2000.

Under this alternative, additional work would be required on the Z83, Z84 and Z89 leach pads to upgrade the reclamation covers to the water barrier or water balance reclamation covers as shown in Figure 2.4-1.

Z85/86 Leach Pad

The Z85/86 leach pad is located at the head of Ruby Gulch. It covers an area of 32.5 acres and contains 4,881,600 cubic yards of spent ore. This pad is due east of the Mint pit and immediately south of Shell Butte. A portion (386,000 cubic yards) of this pad was used for backfill in the O.K./Ruby and Mint pits as part of the Zortman Pit Backfill Interim Reclamation Project. Another 70,000 cubic yards was removed to reclaim the barren pond.

Under the FEIS, the Z85/86 leach pad and dike were to be removed and used as backfill in the O.K./Ruby and Mint pits along with the Alder Gulch waste rock dump. This was changed in the 1998 ROD which specified that the Z85/86 leach pad would be regraded in place to 3H:1V slopes and capped with a water barrier (11.65 acres) or water balance (21.70 acres) cover appropriate to the slope conditions.

The Z85/86 dike occupies 3.61 acres and contains 229,200 cubic yards of sulfide material. The dike would be regraded or buttressed to achieve a 2.5H:1V slope. This flattened slope would be reclaimed with a water balance cover.

Waste Rock Dump Reclamation

There are five waste rock repositories at the Zortman Mine: the Alder Gulch waste rock dump, O.K. waste rock dump, South Ruby waste rock dump, Z82 sulfide stockpile and Ruby sulfide stockpile.

Alder Gulch Waste Rock Dump

The Alder Gulch waste rock dump occupies a draw on the northeast side of Carter Gulch. The top bench on the dump juts out from the ridge separating the Alder Gulch, Carter Gulch and Ruby Gulch drainages. The main access road cuts between the top of the rock dump and the Z82 leach pad. The top of the dump sits at an elevation of 5005 feet amsl. Its toe extends down to an elevation of 4625 feet amsl. The Alder Gulch waste rock dump contains an estimated 2,236,000 cubic yards of acid generating waste rock. A seepage capture system has been constructed below the toe of the dump. The dump has a 17.94-acre footprint which was reclaimed by ZMI in 1991 and 1992 by placing 8 to 12 inches of soil as cover material and reseeding. Lined surface runoff drains have been constructed across the dump face. Surface reclamation on this dump face failed several times prior to placement of the runoff drains across its surface.

The Alder Gulch waste rock dump would be removed and used as backfill in the O.K./Ruby pit. The footprint from the dump would be tested on 100-foot centers for acid generating potential. Those areas with total sulfur content greater than 0.5% sulfur would either be limed or capped to provide at least 12 inches of NAG beneath a 12-inch layer of soil. The entire area would be revegetated.

<u>O.K. Waste Rock Dump</u>

The O.K. waste rock dump occupies a draw on the west side of Ruby Gulch. The dump is situated between the south end of the O.K./Ruby pit and the north end of the Z82 leach pad. The top of the dump sits at an elevation of 5035 feet amsl. Its toe extends down to an elevation of 4770 feet amsl. Below the toe, the drainage is blocked by the Z85/86 leach pad. The O.K. waste rock dump contains an estimated 746,000 cubic yards of waste rock. Its footprint covers 8.69 acres. The face of the dump was reclaimed in 1993 with a cover of 8 to 12 inches of soil and was seeded. The Z82 soil stockpile, which covered a portion of this dump's top bench, was removed and used to cover the Z83 and Z89 leach pads.

The O.K. waste rock dump would be removed and used as backfill in the O.K./Ruby and Mint pits. The dump footprint would be tested on 100-foot centers for acid generating potential. Those areas with total sulfur content greater than 0.5% sulfur would either be limed or capped with a layer of NAG. After placing 12 inches of soil on the surface, the area would be revegetated.

<u>South Ruby Waste Rock Dump</u>

The South Ruby waste rock dump was located at the head of Ruby Gulch. It was situated across the road and just to the east of the O.K./Ruby pit. Before this dump was partially removed and regraded in 2000-2001, it contained an estimated 550,000 cubic yards of waste rock and covered over 15 acres of land straddling the drainage at the head of the gulch. The top of the dump was at an elevation of 5050 feet amsl. The dump toe had extended down into the Mint pit at an elevation of 4875 feet amsl.

A total of 281,000 cubic yards was cut off the top of the dump and backfilled into the O.K./Ruby pit. Approximately 158,000 cubic yards was pushed into the Mint pit backfill area. The remainder of the pile, about 111,000 cubic yards, was regraded in place. Final reclamation of the dump footprint would include application of 12 inches of NAG, 12 inches of soil, and revegetation.

<u>Z82 Sulfide Stockpile</u>

The Z82 sulfide stockpile contained 30,000 cubic yards of sulfide rock and was located on top of the Z82 leach pad. The Z82 sulfide stockpile was placed into the bottom of the O.K. pit as part of interim reclamation. The Ruby sulfide stockpile was also placed in the bottom of the O.K. pit. Both were capped with 6 inches of clay prior to backfilling all of the O.K./Ruby pit as part of the Zortman Pit Backfill Interim Reclamation Project. No further reclamation action would be conducted on this stockpile.

Ruby Sulfide Stockpile

The Ruby sulfide stockpile contained 135,000 cubic yards of sulfide rock and was located on top of the South Ruby waste rock dump. This material was placed in the bottom of the O.K. pit along with the Z82 sulfide stockpile. The sulfide disposal area was capped with 6 inches of clay prior to backfilling all of the O.K./Ruby pit as part of the Zortman Pit Backfill Interim Reclamation Project. No further reclamation action would be conducted on this stockpile.

Ruby Gulch Tailings

The Ruby Gulch tailings were generated by mining operations in Ruby Gulch dating back to the early 1900s. The tailings are located in Ruby Gulch, downstream of the Ruby Gulch pumpback system, at the toe of the Ruby Gulch Pond embankment. They extend all the way downstream through the town of Zortman and end shortly before reaching Goslin Flats. ZMI excavated some of the tailings from the drainage in order to construct the seepage capture pond. The excavated tailings were stockpiled adjacent the mine access road. There are four main portions or deposits of tailings:

1. The West tailings stockpile, which is located above the access road going up Ruby Gulch, contains approximately 102,700 cubic yards and covers an area of 2.11 acres.

2. The East tailings stockpile contains about 91,700 cubic yards and covers an area of 3.38 acres.

3. The tailings in the drainage bottom between the pumpback and the Zortman guard shack cover an area of 19.4 acres and include approximately 191,200 cubic yards.

4. The amount of tailings going through the town of Zortman is uncertain. Cleanup of this portion of the tailings is not considered as part of the reclamation effort, but is planned to be conducted in conjunction with mine reclamation activity to increase removal efficiency.

The Ruby Gulch drainage bottom, from the Ruby Gulch pumpback station to the Zortman guard shack on the upstream edge of town, would be restored by removal of tailings in the two stockpiles and in the stream bottom. The streambed would be reconstructed and sediment controls would be put into place. The county road would be moved to the east side of the drainage onto the old roadbed and widened. Tailings removed from the stockpiles and streambed would be hauled up to the mine area where they would be spread as NAG or cover material. The tailings have been sampled and found to be non-acid generating. The entire drainage area would be covered with 12 inches of soil and revegetated. The soil would be excavated from Goslin Flats and hauled to the Ruby Gulch area.

Reclamation Covers

In developing a reclamation cover system for the Zortman Mine, the FEIS assumed that most of the waste rock and spent ore heap facilities contained potentially acid generating materials. As a result, one of the requirements of the FEIS Alternative 3 was to develop reclamation covers that would support revegetation and limit the surface water infiltration that could lead to the formation of acidic leachate. The cover systems included water barrier (for slopes less than 25%) and water balance (for slopes greater than 25%) covers on both mines. The water barrier cover would consist of a GCL layer placed over NAG waste and overlain by 36 inches of NAG and 12 inches of soil. The water balance cover would consist of a filter fabric (or geotextile) placed on top of 12 inches of NAG waste and overlain by 24 inches of subsoil and 12 inches of soil. Most other areas would be covered with 12 inches of NAG and 12 inches of soil. Additional detail on the reclamation covers is shown in Figure 2.4-1 and in Appendix B.

Support Facilities Reclamation

All of the support facilities (shops, refinery, processing plant, etc.) would be removed and their footprints covered with 12 inches of soil and revegetated. The water treatment plant, drainage capture systems, ponds, and associated structures would stay in operation in their current locations.

<u>Limestone Quarry</u>

This alternative would use an additional 490,200 loose cubic yards of NAG in the reclamation effort. The material would be quarried from limestone quarry LS-2. The soil would be stripped from the quarry area and stockpiled for use in reclamation. After the limestone is mined, the area would be regraded, covered with soil, and revegetated.

Alternative Z2, Optimize Water Treatment

Alternative Z2 is designed to be affordable within the current reclamation bond funding. The goal of this alternative is to optimize the economics of the water treatment plant operations. This alternative would first use the reclamation funds to relocate the Zortman Mine water treatment plant to Goslin Flats, so that long-term cost savings could be realized by using gravity flow to minimize pumping and lime delivery expenses. The remainder of the funds would then be applied to reclamation measures such as grading, backfilling, topsoiling and revegetation. The reclamation action for each mine feature is shown in Figure 2.4-4. Those mine features that would be considered reclaimed, and not receiving additional reclamation work under this alternative, are marked “No Action” or “Reclaimed in 2000-2001.”

Mine Pit Reclamation

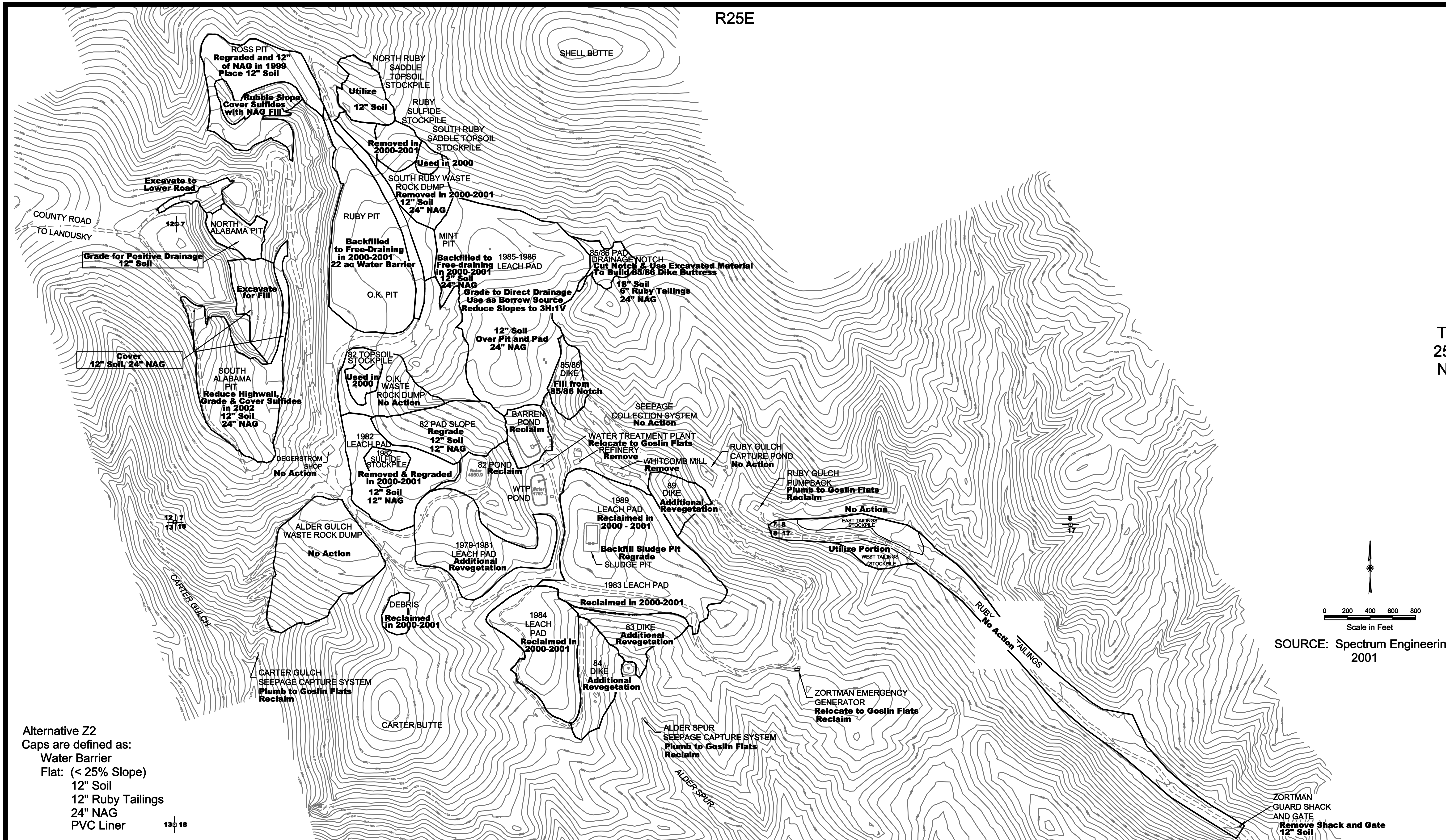
North Alabama and South Alabama Pits

The South Alabama pit grading would be complete after the interim highwall reduction and backfilling work in 2001. The interim backfill would leave a small section of highwall at the north end of the pit. Below this highwall at the upper end of the pit, some of the backfill would be left as steep rubble slopes. The remainder of the backfilled pit, the associated borrow areas, and the pit access road would be covered with 12 inches of soil and revegetated. Only non-acid generating material would be used as backfill. The final configuration would provide a free draining backfill surface which would cover all sulfide areas in the pit.

The North Alabama pit would be made free draining with very minimal earthwork and no need for backfill from external sources. The pit floor would be covered with 12 inches of soil and revegetated. Upon completion, all of the highwalls associated with the North Alabama pit (about 220 vertical feet) would be exposed.

Ross Pit

The Ross pit area was partially regraded in 1999, and the flat pit bench was amended with lime to prevent acid generation. Additional interim work in 2001-2002 would cover a portion of the sulfide-bearing highwall and a lower sulfide bench with non-acid generating material. The backfill placed over the highwall would be left as steep rubble slope. The regraded areas would be covered with12 inches of soil and revegetated. Upon completion of reclamation on the Ross pit about 200 vertical feet of highwall would be exposed; however, most of the sulfides would be covered.



ALTERNATIVE Z2: RECLAMATION GOAL IS TO OPTIMIZE WATER TREATMENT PLANT (WTP) OPERATION BY MOVING WTP TO GOSLIN FLATS AND TO STAY WITHIN THE BOND AMOUNT.

ZORTMAN MINE
ALTERNATIVE Z2

FIGURE 2.4-4

O.K./Ruby and Mint Pits

These pits would be backfilled and graded to drain freely. The entire regraded surface of the O.K./Ruby pit would be covered with clay and a PVC liner, 24 inches of NAG and 12 inches of soil. The Mint pit would be covered with 24 inches of NAG, 12 inches of soil. All pit floors would be revegetated. Upon completion, the highwall of the O.K./ Ruby pit above 5,030 feet (the upper 220 to 300 feet) would be exposed. This would include about 5% of the sulfide-bearing zones in the highwalls.

Leach Pad Reclamation

There are six leach pads at the Zortman Mine. These include the Z79-81, Z82 , Z83, Z84, Z85/86 and Z89 leach pads. The Z79-81 and Z82 leach pads are free draining into ponds. The other pads have buttresses or dikes associated with them. Five of these leach pads would be considered reclaimed.

Z79-81 Leach Pad

The Z79 leach pad has been covered with 8 to 12 inches of soil. Grass was planted in 1989 and trees were planted in 1990. The Z80-81 leach pad was covered with 8 to 12 inches of soil with grass planted in 1991. Trees were planted in 1992. Additional planting and fertilization would be employed to enhance the existing vegetation.

Z82 Leach Pad

The Z82 leach pad was backfilled into the O.K./Ruby pit as part of the Zortman Pit Backfill Interim Reclamation Project. The leach pad footprint would be graded for positive drainage. The steep fill slope directly below the pad would be regraded at 2.5H:1V. The area below the Z82 pond would be graded at 2H:1V. After grading, the entire pad footprint and these regraded slopes would be covered with 12 inches of NAG, 12 inches of soil, and revegetated.

Z83, Z84, and Z89 Leach Pads

The reclamation done to date on the leach pad retaining dikes would be considered complete. The 6.02-acre Z83 dike was covered with 8 to 12 inches of soil and revegetated in 1992. The Z84 dike, occupying 6.73 acres, was covered with 8 to 12 inches of soil and revegetated in 1992. The Z89 dike, covering 3.87 acres, was covered with 8 to 12 inches of soil and revegetated with grass and trees between 1989 and 1990. Additional planting and fertilization would be conducted to enhance the existing vegetation on these dikes.

Interim reclamation during 1999 and 2000 included regrading the Z83, Z84 and Z89 leach pads to 3H:1V slopes. The regraded surface was sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of Ruby

Gulch tailings were placed as cover material, followed by 18 inches of soil. All surfaces were seeded in December 2000. This reclamation work would be considered final. After relocating the water treatment plant to Goslin Flats, the sludge pit on the Z89 leach pad would be backfilled, covered with soil, and revegetated.

Z85/86 Leach Pad

The north half of the Z85/86 leach pad would be used as a backfill source for reclamation of the O.K./Ruby and Mint pits. This area would be regraded to convey runoff around the north edge of the site and into an undisturbed drainage to the east. A portion of the pad would also be excavated to provide about 70,000 cubic yards of material for reclamation of the barren pond.

The remainder of the Z85/86 leach pad would be regraded to 3H:1V slopes. The top 2 feet of the entire pad area would be amended with lime to ensure that it would be non-acid generating. The area would then be covered with 12 inches of soil and revegetated. The Z85/86 dike face would be covered with 42,000 cubic yards of NAG generated while constructing the channel around the north edge of the pad. The NAG fill would be covered with 12 inches of soil and revegetated.

Waste Rock Dump Reclamation

Alder Gulch Waste Rock Dump

The Alder Gulch waste rock dump would not be removed. The existing reclamation on the dump surface would be the final reclamation.

O.K. Waste Rock Dump

The O.K. waste rock dump would not be removed. The existing reclamation on the dump surface would be the final reclamation.

South Ruby Waste Rock Dump

The upper portion of this dump would be used for O.K./Ruby and Mit pit backfill. The remaining 111,000 cubic yards of the South Ruby waste rock dump that was not used as pit backfill would be regraded in place as part of interim reclamation. The regraded dump surface would be covered with 12 inches of NAG, 12 inches of soil, and revegetated.

Z82 Sulfide Stockpile

The Z82 sulfide stockpile was placed into the bottom of the O.K. pit, capped with clay and then buried below 100 feet of backfill as part of interim reclamation.

Ruby Sulfide Stockpile

The Ruby sulfide stockpile was placed into the bottom of the O.K. pit along with the Z82 sulfide stockpile as part of interim reclamation, capped with clay and then buried below 100 feet of backfill. The footprint would be reclaimed as part of the South Ruby waste rock dump.

Ruby Gulch Tailings

Reclamation of the Ruby Gulch tailings in the lower portion of the drainage would not take place as part of mine reclamation. A portion of the West tailings stockpile was removed as part of interim reclamation and used for cover soil on the Z83, Z84, and Z89 leach pads.

Support Facilities Reclamation

All of the support facilities such as shops, the refinery, processing plants, etc. would be removed and their footprints covered with 12 inches of soil and revegetated. The water treatment plant, ponds, and associated structures would be relocated to Goslin Flats. Pipelines would be constructed to route captured seepage to the Goslin Flats water treatment plant. When no longer needed, the Goslin Flats water treatment plant would be dismantled and the disturbance footprint reclaimed with 12 inches of soil and revegetated.

Alternative Z3, Optimize Source Control

Alternative Z3 is similar to Alternative Z2 in that it is designed to be implemented within the current reclamation bond funding. In this alternative, the water treatment plant would be left where it is currently located. The reclamation funds would be used to buttress the Z85/86 dike and to create a 24-inch thick NAG zone over acid generating surfaces by lime amendment. In most areas a growth medium of 7 inches of tailings and 11 inches of soil would be placed before revegetation. The reclamation action for each mine feature is shown in Figure 2.4-5. Those mine features that would be considered reclaimed, and not receiving additional reclamation work under this alternative, are marked “No Action” or “Reclaimed in 2000-2001.”

Mine Pit Reclamation

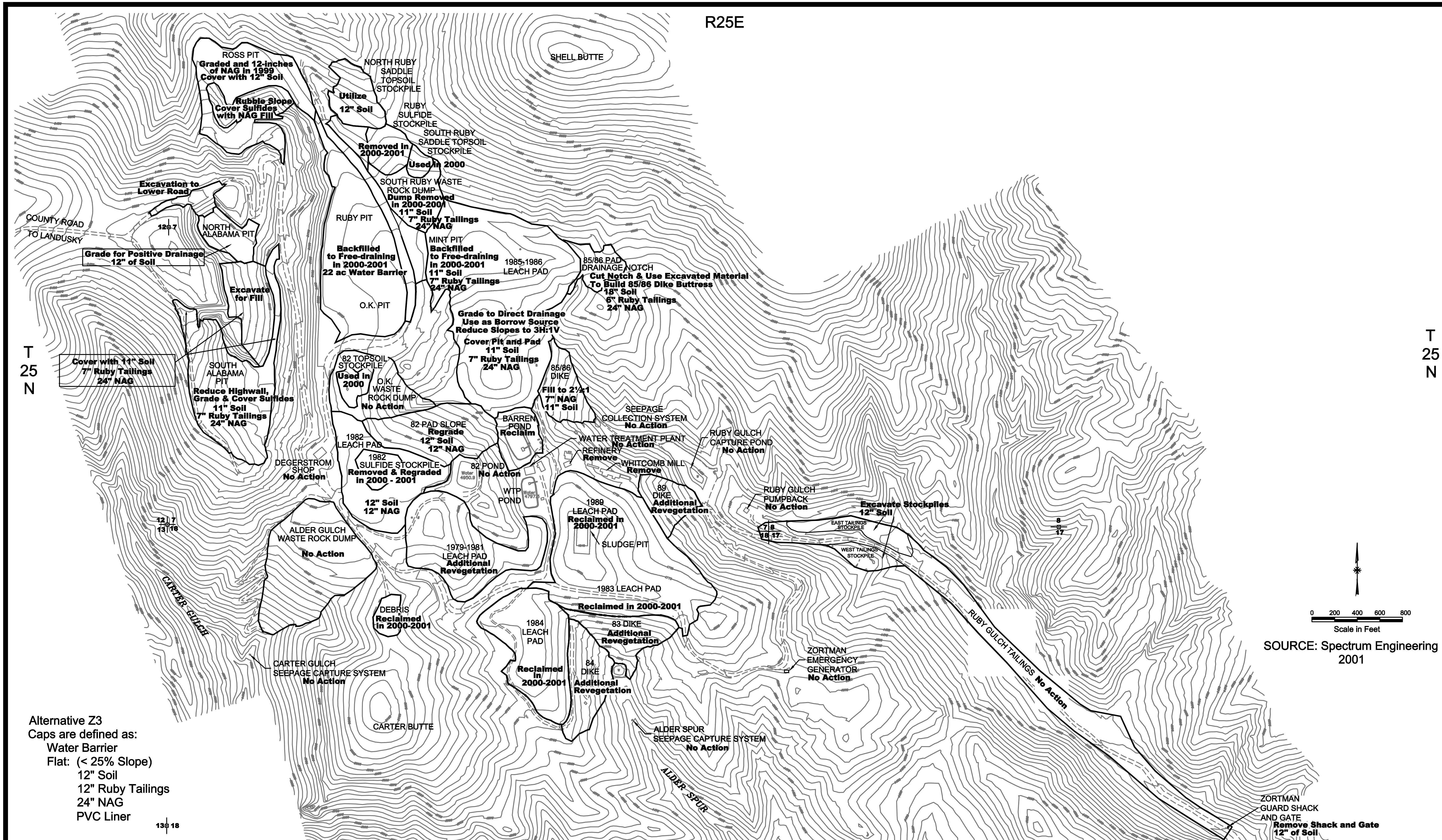
North Alabama and South Alabama Pits

The South Alabama pit grading would be complete after the interim highwall reduction and backfilling work in 2001. The interim backfill would leave a small section of highwall at the north end of the pit. Below this highwall at the upper end of the pit, some of the backfill would be left as steep rubble slopes. The remainder of the backfilled pit, the associated borrow areas, and the pit access road would be covered with 7 inches of Ruby Gulch tailings, 11 inches of soil, and revegetated. Only non-acid generating material would be used as backfill. The final configuration would provide a free draining backfill surface which would cover all sulfide areas in the pit.

The North Alabama pit would be made free draining with minimal earthwork and no need for backfill from external sources. The upper bench between the north and south pits would be covered with 7 inches of Ruby Gulch tailings, 11 inches of soil, and revegetated. The North Alabama pit floor would be covered with 12 inches of soil and revegetated. Upon completion, the highwalls associated with the North Alabama pit (about 220 vertical feet) would be exposed.

Ross Pit

The Ross pit area was partially regraded in 1999, and the flat pit bench was amended with lime to prevent acid generation. Additional interim work in 2001-2002 would cover a portion of the sulfide-bearing highwall and a lower sulfide bench with non-acid generating material. The backfill placed over the highwall would be left as steep rubble slope. The regraded areas would be covered with12 inches of soil and revegetated. Upon completion of reclamation on the Ross pit about 200 vertical feet of highwall would be exposed; however, most of the sulfides would be covered.



ALTERNATIVE Z3: RECLAMATION GOAL IS TO OPTIMIZE SOURCE CONTROL WITHIN THE BOND AMOUNT.

ZORTMAN MINE
ALTERNATIVE Z3

FIGURE 2.4-5

O.K./Ruby and Mint Pits

The O.K./Ruby and Mint pits would be backfilled to relatively flat, free-draining surfaces. The O.K./Ruby pit would be covered with clay and a PVC liner. Then the top 24 inches of material placed in the backfill would be NAG. The NAG fill would be covered with 7-12 inches of Ruby Gulch tailings, 11-12 inches of soil, and revegetated. Upon completion, the highwall of the O.K./Ruby pit above 5,030 feet (the upper 220-300 feet) would be exposed. About 5% of the sulfide zones in the highwalls would be exposed.

Leach Pad Reclamation

There are six leach pads at the Zortman Mine. These include the Z79-81, Z82 , Z83, Z84, Z85/86 and Z89 leach pads. The Z79-81 and Z82 leach pads are free draining into ponds. The other pads have buttresses or dikes associated with them. The existing reclamation on five of these leach pads would be considered final.

Z79-81 Leach Pad

The Z79 leach pad has been covered with 8 to 12 inches of soil. Grass was planted in 1989 and trees were planted in 1990. The Z80-81 leach pad was covered with 8 to 12 inches of soil with grass planted in 1991. Trees were planted in 1992. Additional planting and fertilization would be conducted to enhance the existing vegetation.

Z82 Leach Pad

The Z82 leach pad was backfilled into the O.K./Ruby pit as part of the Zortman Pit Backfill Interim Reclamation Project. The leach pad footprint would be graded for positive drainage. The steep fill slope directly below the pad would be regraded at 2.5H:1V. The area below the Z82 pond would be graded at 2H:1V. After grading, the entire pad footprint and these regraded slopes would be covered with 12 inches of NAG, 12 inches of soil, and revegetated.

Z83, Z84, and Z89 Leach Pads

The reclamation done to date on the leach pad retaining dikes would be considered complete. The 6.02-acre Z83 dike was covered with 8 to 12 inches of soil and revegetated in 1992. The Z84 dike, occupying 6.73 acres, was covered with 8 to 12 inches of soil and revegetated in 1992. The Z89 dike, covering 3.87 acres, was covered with 8 to 12 inches of soil and revegetated with grass and trees between 1989 and 1990. Additional planting and fertilization would be conducted to enhance the existing vegetation on these dikes.

Interim reclamation during 1999 through 2001 included regrading the Z83, Z84 and Z89 leach pads to 3H:1V slopes. The regraded surface was sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of Ruby Gulch tailings were placed as cover material, followed by 18 inches of soil. All surfaces were seeded in late 2000. This interim reclamation work would be considered final on the Z83, Z84 and Z89 leach pads.

The water treatment plant sludge pit on the Z89 leach pad is expected to be used for many years, as long as the water treatment plant is in operation. When no longer needed the sludge pit would be regraded, covered with soil, and revegetated.

Z85/86 Leach Pad

The north half of the Z85/86 leach pad would be used as a backfill source for reclamation of the O.K./Ruby and Mint pits. This area would be regraded to convey runoff around the north edge of the site and into an undisturbed drainage to the east. A portion of the pad would be excavated to provide about 70,000 cubic yards of material for reclamation of the barren pond.

The remainder of the Z85/86 leach pad would be regraded to 3H:1V slopes. The top 2 feet would be lime amended to ensure 24 inches of NAG. Seven inches of Ruby Gulch tailings and 11 inches of soil would then be placed as cover and the surface would be revegetated. The Z85/86 dike face would be buttressed with 133,000 cubic yards of NAG-quality material to achieve a 2.5H:1V slope. About 42,000 cubic yards of this material would be placed over the dike face during construction of the Z85/86 pad drainage notch. This flattened slope would be covered with 7 inches of NAG, 11 inches of soil, and revegetated.

Waste Rock Dump Reclamation

Alder Gulch Waste Rock Dump

The Alder Gulch waste rock dump would not be removed. The existing reclamation on the dump surface would be the final reclamation.

O.K. Waste Rock Dump

The O.K. waste rock dump would not be removed. The existing reclamation on the dump surface would be left as the final reclamation.

South Ruby Waste Rock Dump

The upper portion of this dump would be used for O.K./Ruby and Mint pit backfill. The remaining 111,000 cubic yards of the South Ruby waste rock dump that was not used as pit backfill would be regraded in place. The top 24 inches of the dump footprint would be amended with lime to produce a

NAG base. The regraded surface would be covered with 7 inches of tailings, 11 inches of soil, and revegetated.

Z82 Sulfide Stockpile

The Z82 sulfide stockpile was placed into the bottom of the O.K. pit, capped with clay and then buried below 100 feet of backfill as part of interim reclamation.

Ruby Sulfide Stockpile

The Ruby sulfide stockpile was placed into the bottom of the O.K. pit along with the Z82 sulfide stockpile, capped with clay and then buried below 100 feet of backfill as part of interim reclamation. The footprint would be reclaimed as part of the South Ruby waste rock dump.

Ruby Gulch Tailings

A portion of the West tailings stockpile was removed to use as soil cover on the Z83, Z84 and Z89 leach pads. The remainder of the West tailings stockpile and the East tailings stockpile would be used as NAG and to supplement the cover soil for the South Alabama, O.K./Ruby, and Mint pits and on the Z85/86 leach pad.

Support Facilities Reclamation

All of the support facilities such as shops, refinery, processing plants, etc. would be removed and their footprints covered with 12 inches of soil and revegetated. The water treatment plant, drainage capture systems, ponds, and associated structures would stay in operation in their current locations. When no longer needed, the water treatment facilities would be removed and their footprint area reclaimed. This alternative does not require additional NAG beyond what would be obtained from the Ruby Gulch tailings stockpiles for the reclamation effort. No new disturbance would be required.

Alternative Z4, Additional Backfilling

Alternative Z4 would not be limited by funding available under the reclamation bonds. The earthwork portion of this alternative is similar to Alternative Z1 with additional backfilling of the mine pits. All acid generating source areas would be covered with a water barrier or water balance reclamation cover, depending upon the steepness of the regraded slope. The reclamation action for each mine feature is shown in Figure 2.4-6. Those mine features that would be considered reclaimed, and not receiving additional reclamation work under this alternative, are marked “No Action” or “Reclaimed in 2000-2001.”

Mine Pit Reclamation

North Alabama and South Alabama Pits

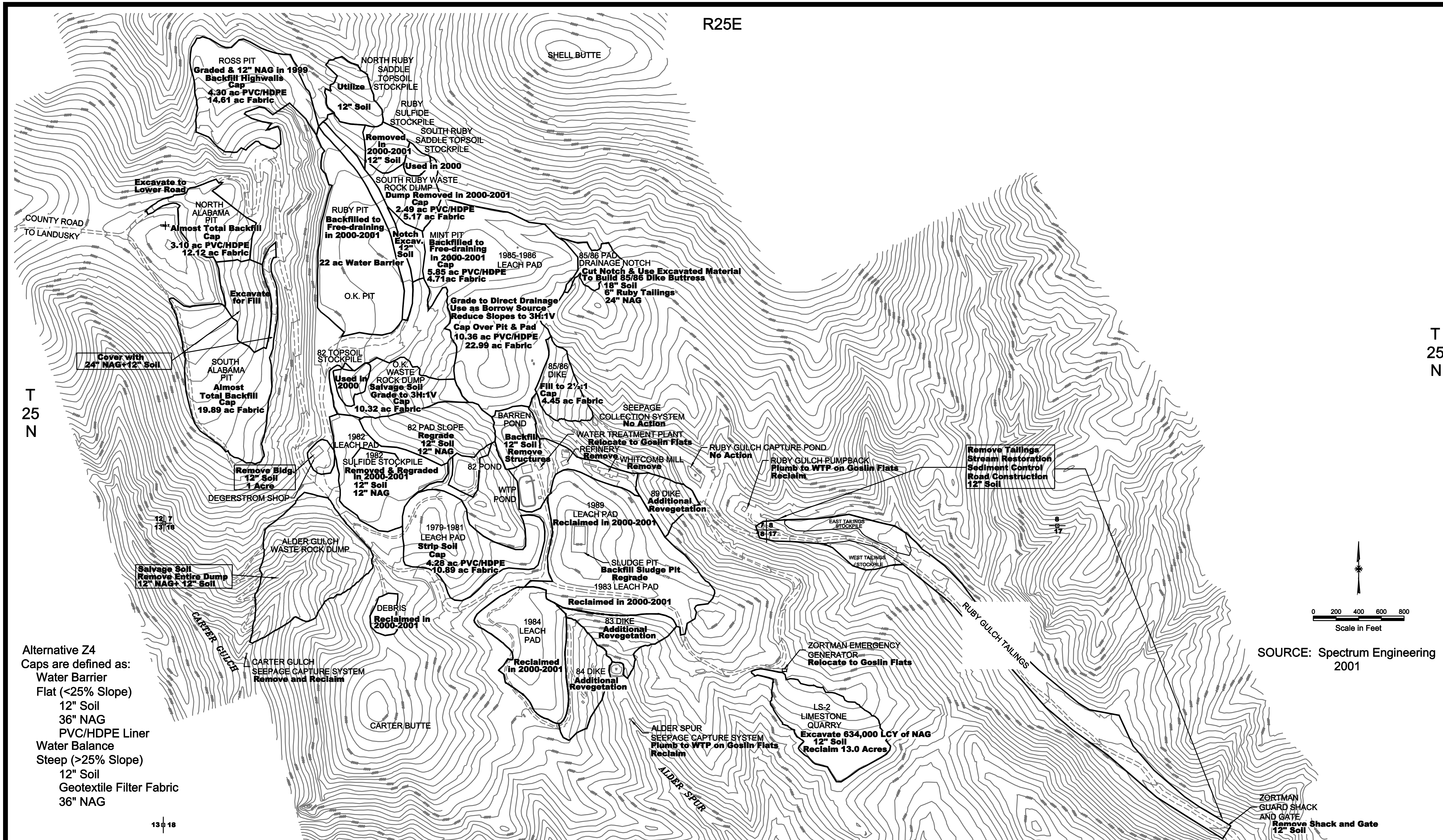
The North Alabama pit would be almost completely backfilled with material from the Alder Gulch waste rock dump. The west highwall of the South Alabama pit would first be reduced by blasting then the remainder of the pit would be almost completely backfilled with material from the Alder Gulch waste rock dump. The regraded areas would be covered with 4-foot thick water barrier or water balance reclamation covers and revegetated. Upon completion, a maximum of 90 vertical feet of the North Alabama pit highwall would be exposed and 50 vertical feet of the South Alabama pit highwall on the north end of the pit would be exposed.

Ross Pit

In addition to interim grading and backfilling, all of the sulfide zones in the highwalls within the Ross pit would be covered with material from the Alder Gulch waste rock dump. The Ross pit would be backfilled to an overall slope of 2.7H:1V. A flat spot 300 feet deep into the hillside and 600 feet along the hillside would not be backfilled. A small section at the top of the highwall would also be left uncovered by backfill. The slopes would be covered with a geotextile filter fabric and the flat bench would be covered with a geosynthetic liner. The reclamation covers would consist of 36 inches of NAG, 12 inches of soil, and revegetation. Upon completion, only a small upper area of the highwall would be left exposed.

O.K./Ruby and Mint Pits

The O.K./Ruby and Mint pits would be backfilled to free draining surfaces. The graded backfill surface on the O.K./Ruby would be lined with clay before being covered with 20.33 acres of water barrier cover and 1.10 acres of water balance cover. The Mint would be covered with 5.85 acres of water barrier cover and 4.71 acres of water balance cover. The water barrier covers would consist of a geosynthetic liner covered by 36 inches of NAG and 12 inches of soil. The water barrier covers would be constructed with geotextile filter fabric sandwiched between 36 inches of NAG and 12 inches of soil. Upon completion, most of the O.K./Ruby pit highwall above 5,030 feet (the upper 200-280 feet) would be left exposed.



ALTERNATIVE Z4: RECLAMATION GOAL IS TO BACKFILL ALL PITS AND PARTIALLY BACKFILL THE HIGHWALLS. PITS ARE COVERED WITH GEOSYNTHETIC LINERS IN ASSOCIATION WITH THREE FEET OF NAG AND/OR TAILINGS AND ONE FOOT OF SOIL.

ZORTMAN MINE
ALTERNATIVE Z4

FIGURE 2.4-6

Leach Pad Reclamation

There are six leach pads at the Zortman Mine. These include the Z79-81, Z82 , Z83, Z84, Z85/86 and Z89 leach pads. The Z79-81 and Z82 leach pads are free draining into ponds. The other leach pads have buttresses or dikes associated with them.

<u>Z79-81 Leach Pad</u>

The Z79 leach pad has been covered with 8 to 12 inches of soil. Grass was planted in 1989 and trees were planted in 1990. The Z80-81 leach pads were covered with 8 to 12 inches of soil with grass planted in 1991. Trees were planted in 1992. Due to the sparseness of the existing revegetation, the existing vegetation and soil would be stripped from the Z79 and Z80-81 leach pads. The surface would be covered with water barrier or water balance covers, depending on slope steepness, and revegetated.

<u>Z82 Leach Pad</u>

The Z82 leach pad was backfilled into the O.K./Ruby pit as part of the Zortman Pit Backfill Interim Reclamation Project. The leach pad footprint would be graded for positive drainage. The steep fill slope directly below the pad would be regraded at 2.5H:1V. The area below the Z82 pond would be graded at 2H:1V. After grading, the entire pad footprint and these regraded slopes would be covered with 12 inches of NAG, 12 inches of soil, and revegetated.

<u>Z83, Z84, and Z89 Leach Pads</u>

Reclamation work was conducted on these leach pad dikes about ten years ago. The 6.02-acre Z83 dike was covered with 8 to 12 inches of soil and revegetated in 1992. The Z84 dike, occupying 6.73 acres, was covered with 8 to 12 inches of soil and revegetated in 1992. The Z89 dike, covering 3.87 acres, was covered with 8 to 12 inches of soil and revegetated with grass and trees between 1989 and 1990. Additional planting and fertilization would be conducted to enhance the existing vegetation on these dikes.

Interim reclamation during 1999 through 2001 included regrading the Z83, Z84 and Z89 leach pads to 3H:1V slopes. The regraded surface was sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of Ruby Gulch tailings were placed as cover material, followed by 18 inches of soil. All surfaces were seeded in later 2000. The interim reclamation on these leach pads would be considered final.

After relocating the water treatment plant to Goslin Flats, the sludge pit on the Z89 leach pad would be backfilled, covered with soil, and revegetated.

Z85/86 Leach Pad

The north half of the Z85/86 leach pad would be used as a backfill source for reclamation of the O.K./Ruby and Mint pits. This area would be regraded to convey runoff around the north edge of the site and into an undisturbed drainage to the east. A portion of the pad would be excavated to provide about 70,000 cubic yards of material for reclamation of the barren pond.

The remainder of the Z85/86 leach pad would be regraded to 3H:1V slopes. The entire pad would be covered with 10.36 acres of water barrier cover and 22.99 acres of water balance cover, depending on slope steepness. The leach pad would then be revegetated. The Z85/86 dike face would be buttressed with 133,000 cubic yards of NAG-quality material to achieve a 2.5H:1V slope. About 42,000 cubic yards of this material would be placed over the dike face during construction of the Z85/86 pad drainage notch. This flattened slope would be covered with a water balance cover consisting of 36 inches of NAG, a geotextile filter fabric, 12 inches of soil, and revegetated.

Waste Rock Dump Reclamation

Alder Gulch Waste Rock Dump

The entire Alder Gulch waste rock dump would be removed and used to backfill the North Alabama, South Alabama, and Ross pits. The regraded footprint would be sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential would be neutralized with lime. After liming, 12 inches of NAG would be placed as cover, followed by 12 inches of soil, and the area would be revegetated.

O.K. Waste Rock Dump

The O.K. waste rock dump would be re-reclaimed. The soil would be stripped and the dump regraded to 3H:1V slopes. The regraded surface would be tested and lime would be applied to neutralize areas with a net acid generating potential. The surface would then be covered with 36 inches of NAG, a geotextile filter fabric, 12 inches of soil, and revegetated.

South Ruby Waste Rock Dump

The upper portion of this dump would be used for O.K./Ruby and Mit pit backfill. The remainder of the South Ruby waste rock dump that was not placed as pit backfill (about 111,000 cubic yards) would be regraded in place. The regraded dump surface would be covered with 2.49 acres of water barrier and 5.17 acres of water balance cover, depending on slope steepness. In those areas of the footprint where native ground would be exposed, the reclamation cover would be 12 inches of soil.

Z82 Sulfide Stockpile

The Z82 sulfide stockpile was placed into the bottom of the O.K. pit, capped with clay and then buried below 100 feet of backfill as part of interim reclamation.

Ruby Sulfide Stockpile

The Ruby sulfide stockpile was placed into the bottom of the O.K. pit along with the Z82 sulfide stockpile, capped with clay and then buried below 100 feet of backfill. The footprint would be reclaimed as part of the South Ruby waste rock dump.

Ruby Gulch Tailings

The Ruby Gulch drainage bottom from the Ruby Gulch pumpback to the Zortman guard shack would be restored by removal of the tailings in the two stockpiles and in the stream bottom. The streambed would be reconstructed and sediment controls would be put into place. The county road would be moved from the drainage bottom to the old roadbed on the north side of the drainage. Tailings removed from the stockpiles and streambed would be hauled up to the mine area where they would be spread as part of the reclamation cover material. The entire drainage area would be covered with 12 inches of soil over the native ground surface and revegetated. The soil used for reclamation would be stripped from the water treatment plant construction area on Goslin Flats.

Support Facilities Reclamation

All of the support facilities would be removed and their footprints covered with 12 inches of soil and revegetated. The water treatment plant, ponds, and associated structures would be relocated to Goslin Flats. Pipelines would be constructed to route captured seepage to the Goslin Flats water treatment plant. When no longer needed, the Goslin Flats water treatment plant would be dismantled and the disturbance footprint reclaimed with 12 inches of soil and revegetated.

Limestone Quarry

Approximately 634,000 loose cubic yards of NAG would be mined for use in reclamation. This material would be quarried from the 13-acre limestone quarry LS-2. The soil would be stripped from the quarry area and stockpiled for use in reclamation. After the limestone is mined, the area would be regraded, covered with soil, and revegetated.

Alternative Z5, Extensive Backfilling

This alternative includes complete backfilling of all mine pits to approximate pre-mine topography using the Alder Gulch waste rock dump and the Z85/86 leach pad as sources of fill. A water barrier cover would be used only over the O.K./Ruby pit. Other reclaimed surfaces would be covered with 8 inches of soil and 10 to 34 inches of tailings or NAG. Where feasible, lime amendment in the top 24 inches of the regraded surface would be utilized in place of hauling in NAG. The reclamation action for each mine feature is shown in Figure 2.4-7. Those mine features that would be considered reclaimed, and not receiving additional reclamation work under this alternative, are marked “No Action” or “Reclaimed in 2000-2001.”

Mine Pit Reclamation

<u>North Alabama and South Alabama Pits</u>

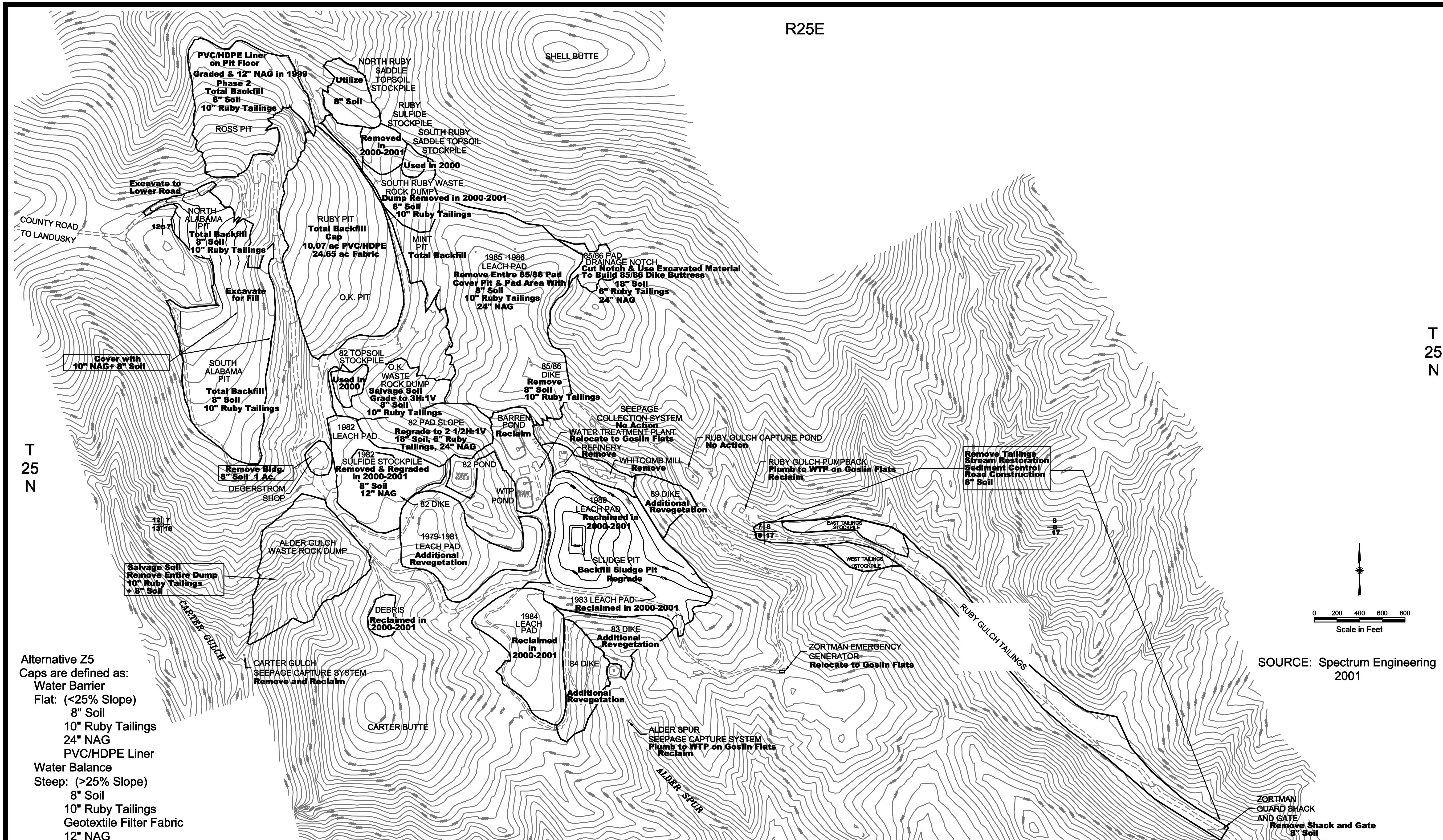
The North and South Alabama pits would be backfilled with material from the Alder Gulch waste rock dump and the Z85/86 leach pad. The North Alabama would receive an additional 92,000 cubic yards more backfill under Alternative Z5 than under Alternative Z4. Reclamation of the South Alabama would also involve reduction of its west highwall. The regraded surfaces would be covered with 10 inches of tailings, 8 inches of soil, and revegetated. Upon completion, only small portions of the highwall in both pits would be exposed.

<u>Ross Pit</u>

A geosynthetic liner would be installed on the floor of the Ross pit. All of the sulfide highwalls within the Ross pit would be covered by backfill. The Ross pit backfill would be graded to a 3H:1V slope to approximate the pre-mine topography. An estimated 307,000 cubic yards from the Alder Gulch waste rock dump and 632,000 cubic yards from the Z85/86 leach pad would be used as backfill sources. The regraded slopes would be covered with 10 inches of tailings, 8 inches of soil, and revegetated. Upon completion, none of the Ross pit highwall would be exposed.

<u>O.K./Ruby and Mint Pits</u>

An additional 3,909,000 cubic yards of material would be backfilled over the interim reclamation backfill. On the flat slopes (10.07 acres) the O.K./Ruby pit would be capped with a water barrier cover. The steep slopes (24.65 acres) would be covered with a water balance cover. The Mint pit would be covered with 24 inches of NAG, 10 inches of Ruby Gulch tailings, and 8 inches of soil. All surfaces would be revegetated. Upon completion of backfilling and grading, all of the O.K./Ruby and Mint pit highwalls would be covered. No sulfide-bearing highwalls would be exposed.



ALTERNATIVE Z5: RECLAMATION GOAL IS TOTAL BACKFILL OF PITS AND HIGHWALLS.

ZORTMAN MINE
ALTERNATIVE Z5

FIGURE 2.4-7

Leach Pad Reclamation

There are six leach pads at the Zortman Mine. These include the Z79-81, Z82 , Z83, Z84, Z85/86 and Z89 leach pads. The Z79-81 and Z82 leach pads are free draining into ponds. The other leach pads have buttresses or dikes associated with them.

Z79-81 Leach Pad

The Z79 leach pad has been covered with 8 to 12 inches of soil. Grass was planted in 1989 and trees were planted in 1990. The Z80-81 leach pad was covered with 8 to 12 inches of soil with grass planted in 1991. Trees were planted in 1992. Additional planting and fertilization would be conducted to enhance the existing vegetation

Z82 Leach Pad

The Z82 leach pad was backfilled into the O.K./Ruby pit as part of the Zortman Pit Backfill Interim Reclamation Project. The leach pad footprint would be graded for positive drainage. The steep fill slope directly below the pad would be regraded at 2.5H:1V. The area below the Z82 pond would be graded at 2H:1V. After grading, the entire pad footprint and these regraded slopes would be covered with 12 inches of NAG, 8 inches of soil, and revegetated.

Z83, Z84, and Z89 Leach Pads

The reclamation done to date on the leach pad retaining dikes would be considered complete. The 6.02-acre Z83 dike was covered with 8 to 12 inches of soil and revegetated in 1992. The Z84 dike, occupying 6.73 acres, was covered with 8 to 12 inches of soil and revegetated in 1992. The Z89 dike, covering 3.87 acres, was covered with 8 to 12 inches of soil and revegetated with grass and trees between 1989 and 1990. Additional planting and fertilization would be conducted to enhance the existing vegetation on these dikes.

Interim reclamation during 1999 through early 2001 included regrading the Z83, Z84 and Z89 leach pads to 3H:1V slopes. The regraded surface was sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of Ruby Gulch tailings were placed as cover material, followed by 18 inches of soil. All surfaces were seeded in late 2000. This interim reclamation work would be accepted as the final reclamation. After relocating the existing water treatment plant to Goslin Flats, the sludge pit on top of the Z89 leach pad would be backfilled, covered with soil, and revegetated.

Z85/86 Leach Pad

The entire Z85/86 leach pad would be removed from the upper Ruby Gulch drainage and used to backfill the mine pits and the barren pond. The entire leach pad footprint area would be covered with 24 inches of NAG, 10 inches of Ruby Gulch tailings, 8 inches of soil, and revegetated. The entire Z85/86 dike would be removed, restoring the area to its original topography. The footprint area would be covered with 10 inches of Ruby Gulch tailings, 8 inches of soil, and revegetated. The drainage notch used during interim reclamation would be covered with soil and revegetated.

Waste Rock Dump Reclamation

Alder Gulch Waste Rock Dump

The Alder Gulch waste rock dump would be removed and used as backfill in the North Alabama, South Alabama, and Ross pits. The regraded footprint would be sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential would be neutralized with lime. After liming, 10 inches of Ruby Gulch tailings would be placed over the footprint, followed by 8 inches of soil, and the area would be revegetated.

O.K. Waste Rock Dump

The O.K. waste rock dump would be re-reclaimed. Soil would be stripped and the dump would be regraded to 3H:1V slopes. After being sampled for acid generating potential, the surface would be covered with 10 inches of Ruby Gulch tailings, 8 inches of soil, and revegetated.

South Ruby Waste Rock Dump

Most of the South Ruby waste rock dump would be used for O.K./Ruby and Mint pit backfill. About 111,000 cubic yards not used as pit backfill would be regraded in place. The entire regraded surface would be covered with 24 inches of NAG, 10 inches of Ruby Gulch tailings, 8 inches of soil, and revegetated.

Z82 Sulfide Stockpile

The Z82 sulfide stockpile was placed into the bottom of the O.K. pit, capped with clay and then buried below 100 feet of backfill as part of interim reclamation.

Ruby Sulfide Stockpile

The Ruby sulfide stockpile was placed into the bottom of the O.K. pit along with the Z82 sulfide stockpile, capped with clay and then buried below 100 feet of backfill. The footprint would be reclaimed as part of the South Ruby waste rock dump.

Ruby Gulch Tailings

The Ruby Gulch drainage bottom from the Ruby Gulch pumpback to the Zortman guard shack would be restored by removal of the tailings in the two stockpiles and in the stream bottom. The streambed would be reconstructed and sediment controls would be put into place. The county road would be moved from the drainage bottom to the old roadbed on the north slope of the drainage. Tailings removed from the stockpiles and streambed would be hauled up to the mine area where they would be spread as part of the reclamation cover material. The entire drainage area would be covered with 8 inches of soil over the native ground surface and revegetated. The soil used for reclamation would be stripped from the water treatment plant construction area on Goslin Flats.

Support Facilities Reclamation

All of the support facilities would be removed and their footprints covered with 12 inches of soil and revegetated. The water treatment plant, ponds, and associated structures would be relocated to Goslin Flats. Pipelines would be constructed in Ruby Gulch and Alder Gulch to route captured seepage to the Goslin Flats water treatment plant. When no longer needed, the Goslin Flats water treatment plant and the seepage transport pipelines would be dismantled and the disturbance footprint reclaimed with 12 inches of soil and revegetated.

Alternative Z6, Optimize Grading for Source Control (Preferred Alternative)

Alternative Z6 would not be limited by the funding available under the reclamation bonds. The earthwork portion of this alternative combines aspects of Alternatives Z3 and Z4. It limits removal of the Alder Gulch waste rock dump to the top lifts. Material excavated from the Alder Gulch waste rock dump would be placed into the North Alabama pit. Additional backfilling in the Ross pit with NAG from the area between the North and South Alabama pits would be used to cover exposed sulfides. Water barrier reclamation covers would be placed over the excavation area on the Alder Gulch waste rock dump, over the backfilled area in the North Alabama pit, and over the backfill in the O.K./Ruby pit. All other areas would be covered with 6 inches of tailings and 18 inches of soil. Because only about half of the necessary soil would be available on the site, soil would be transferred from the Landusky Mine. The water treatment plant would be left in its present location. The reclamation action for each mine feature is shown in Figure 2.4-8. Those mine features considered reclaimed and not receiving additional reclamation work under this alternative are marked “No Action” or “Reclaimed in 2000-2001.”

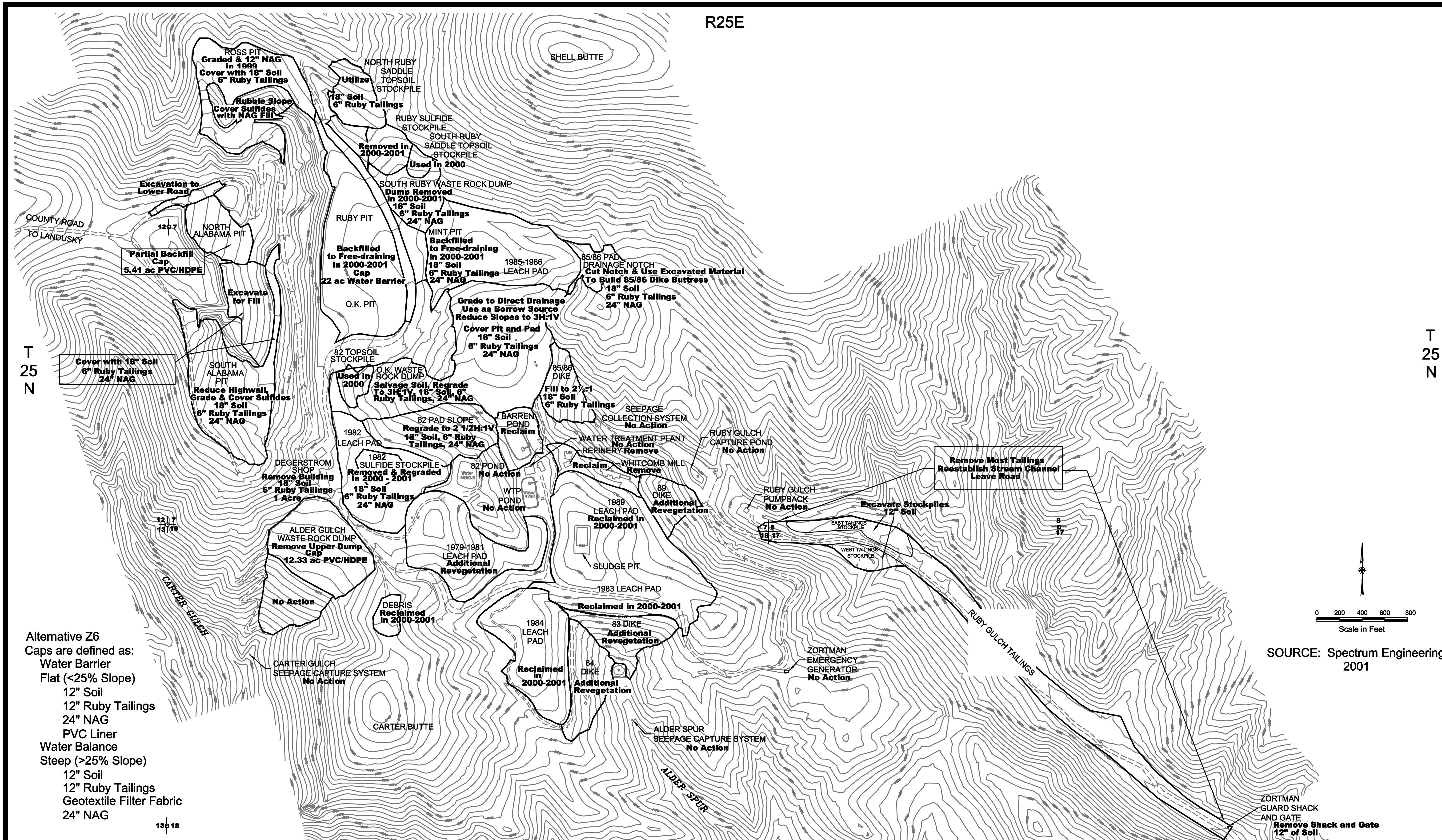
Mine Pit Reclamation

South Alabama Pit

The South Alabama pit grading would be complete after the interim highwall reduction and backfilling work in 2001. The interim backfill would leave a small section of highwall at the north end of the pit. Below this highwall at the upper end of the pit, some of the backfill would be left as steep rubble slopes. The remainder of the backfilled pit, the associated borrow areas, and the pit access road would be covered with 6 inches of tailings, 18 inches of soil, and revegetated. Only non-acid generating material would be used as backfill. The final configuration would provide a free draining backfill surface which would cover all sulfide areas in the pit.

North Alabama Pit

The North Alabama pit would be backfilled with 432,000 cubic yards of material from the Alder Gulch waste rock dump. The backfill would be graded at a 4.5H:1V slope, which would raise the backfill up to the level of the county road on the north wall of the pit. About 100 vertical feet of highwall would remain below the peak on the west side of the pit. A 20-30 foot ledge would also be left exposed on the east side of the pit. The remainder of the pit would be backfilled and completely covered with a synthetic liner. A cover consisting of 24 inches of NAG, 12 inches of tailings, and 12 inches of soil would be placed over the liner and revegetated.



ALTERNATIVE Z6: RECLAMATION GOAL IS TO COVER SULFIDES WITH MINIMAL PIT BACKFILL AND MAXIMIZE AREAS RECLAIMED.

ZORTMAN MINE ALTERNATIVE Z6

FIGURE 2.4-8

Ross Pit

The Ross pit was partially regraded as part of interim reclamation and the flat pit bench was limed to prevent acid generation. A portion of the sulfide-bearing highwall and a lower sulfide bench would be covered with 133,000 cubic yards of non-acid generating material borrowed from the disturbed area between the North and South Alabama pits. About 200 vertical feet of highwall that is partially broken by benches would be left above the backfilled area. The top of the backfill would be configured as a bench extending out from the highwall. Below the graded upper bench, the fill would extend down to the floor of the pit as a steep, rubble slope. The pit floor and all regraded areas except the rubble slope would be covered with 6 inches of tailings, 18 inches of soil, and revegetated.

O.K./Ruby Pit

The O.K./Ruby pit would be backfilled to a free draining configuration. Approximately 22 acres of this backfill surface would be covered with clay, a PVC liner, 24 inches of NAG, 12 inches of tailings and 12 inches of soil. The entire regraded area would be revegetated. Upon completion, most of the O.K./Ruby pit highwall above 5,030 feet (the upper 200-280 feet) would be exposed. However, the backfill would still cover most of the sulfide areas.

Mint Pit

The Mint pit was backfilled under interim reclamation. The backfill surface would be tested for acid generating potential, limed if necessary, and then covered with 6 inches of tailings, 18 inches of soil, and revegetated.

Leach Pad Reclamation

There are six leach pads at the Zortman Mine. These include the Z79-81, Z82, Z83, Z84, Z85/86 and Z89 leach pads. The Z79-81 and Z82 leach pads are free draining into ponds. The other leach pads have buttresses or dikes associated with them.

Z79-81 Leach Pad

The Z79 leach pad has been covered with 8 to 12 inches of soil. Grass was planted in 1989 and trees were planted in 1990. The Z80-81 leach pad was covered with 8 to 12 inches of soil with grass planted in 1991. Trees were planted in 1992. Additional planting and fertilization would be conducted to enhance the existing vegetation.

Z82 Leach Pad

The Z82 leach pad was backfilled into the O.K./Ruby pit as part of the Zortman Pit Backfill Interim Reclamation Project. The leach pad footprint would be graded for positive drainage. The steep fill slope directly below the pad would be regraded to a 2.5H:1V slope. Regrading would also be conducted on the area below the Z82 pond, which would be graded at a 2H:1V slope. After grading, the entire pad footprint and these regraded slopes would be covered with 6 inches of tailings, 18 inches of soil, and revegetated.

Z83, Z84, and Z89 Leach Pads

The reclamation done to date on the leach pad retaining dikes would be considered complete. The 6.02-acre Z83 dike was covered with 8 to 12 inches of soil and revegetated in 1992. The Z84 dike, occupying 6.73 acres, was covered with 8 to 12 inches of soil and revegetated in 1992. The Z89 dike, covering 3.87 acres, was covered with 8 to 12 inches of soil and revegetated with grass and trees between 1989 and 1990. Additional planting and fertilization would be conducted to enhance the existing vegetation.

Interim reclamation during 1999 through 2001 included regrading the Z83, Z84 and Z89 leach pads to 3H:1V slopes. The regraded surfaces were sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of Ruby Gulch tailings were placed as cover material, followed by 18 inches of soil. All surfaces were seeded in late 2000. The interim reclamation on these leach pads would be considered the final reclamation.

The water treatment plant sludge pit on the Z89 leach pad is expected to be used for as long as the water treatment plant is in operation. When no longer needed the sludge pit would be regraded, covered with soil, and revegetated.

Z85/86 Leach Pad

The north half of the Z85/86 leach pad was used as a backfill source for reclamation of the O.K./Ruby and Mint pits. This area would be regraded to convey runoff around the north edge of the site and into an undisturbed draw on the east edge of the site. A portion of the pad would also be excavated to provide about 70,000 cubic yards of material for reclamation of the barren pond and the bench on which it is located.

Approximately 300,000 cubic yards of additional grading would be conducted to regrade the south half of this pad to a free draining surface with maximum 3H:1V slopes. The surface configuration would tie into the O.K. waste rock dump regrade and would include moving part of this material off the lined area to contour adjacent areas. Following grading, the entire pad along with its associated fill and borrow areas would be sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential would be neutralized with lime. After liming, 6 inches of Ruby Gulch tailings and 18 inches of soil would be used to cover the regraded area, and the entire area would then be revegetated.

The Z85/86 dike face would be buttressed with 133,000 cubic yards of NAG-quality material to achieve a 2.5H:1V slope. About 42,000 cubic yards of this material would be placed over the dike face during construction of the Z85/86 leach pad drainage notch. The remainder of the fill would be obtained by selectively excavating material from the O.K. waste rock dump and the Z85/86 leach pad. After grading the fill, 6 inches of Ruby Gulch tailings and 18 inches of topsoil would be used to cover the buttressed area. The entire area would then be revegetated.

Waste Rock Dump Reclamation

Alder Gulch Waste Rock Dump

The upper 432,000 cubic yards in the Alder Gulch waste rock dump would be removed and used to backfill the North Alabama pit. Prior to excavation, the existing reclamation soil would be stripped and stockpiled for re-use. The top section of the dump would then be excavated to a maximum 20% grade so that the entire top of the remaining portion of the dump could be covered with a water barrier cover. The cover would consist of 24 inches of NAG, a geosynthetic liner, 12 inches of tailings, and 12 inches of soil. The redisturbed area would be revegetated.

O.K. Waste Rock Dump

The O.K. waste rock dump would be re-reclaimed. After soil has been salvaged from the dump face, the dump would be regraded to 3H:1V slopes. In conjunction with this work, subsidence areas on the north side of the dump would be backfilled and the sump below the dump would be eliminated. After grading, the regraded surface would be sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential would be neutralized with lime. After liming, 6 inches of tailings would be placed, followed by 18 inches of soil. The regraded area would then be revegetated.

South Ruby Waste Rock Dump

The upper portion of this dump would be used to backfill the O.K./Ruby and Mint pits. The remaining 111,000 cubic yards of the South Ruby waste rock dump that was not used as backfill would be regraded. The regraded surface would be sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential would be neutralized with lime. After liming, 6 inches of tailings would be placed, followed by 18 inches of soil. The reclaimed surface would then be revegetated.

Z82 Sulfide Stockpile

The Z82 sulfide stockpile was placed into the bottom of the O.K. pit, capped with clay and then buried below 100 feet of backfill as part of interim reclamation.

Ruby Sulfide Stockpile

The Ruby sulfide stockpile was placed in the bottom of the O.K. pit along with the Z82 sulfide stockpile as part of interim reclamation. A clay layer was placed over the top of these sulfides and an additional 100 feet of backfill would be placed over this material.

Ruby Gulch Tailings

Nearly all of the tailings in the Ruby Gulch drainage bottom from the Ruby Gulch pumpback to the Zortman guard shack would be used as reclamation materials at the Zortman Mine. After removal of the tailings, the streambed would be reconstructed with sediment controls. The county road would be rebuilt where necessary.

Support Facilities Reclamation

All support facilities such as shops, refinery, processing plants, ponds, etc. would be removed and their footprints covered with 6 inches of tailings, 18 inches of soil, and revegetated. The water treatment plant, drainage capture systems, ponds, and associated structures would stay in operation in their current locations. Once no longer needed, the water treatment facilities would be removed and their footprint area reclaimed with soil and revegetated. This alternative does not require additional NAG to support the reclamation effort beyond what can be obtained from the tailings in Ruby Gulch and from previously disturbed mine areas. There would be no new disturbance to obtain reclamation materials.

2.4.3 Landusky Mine Reclamation Alternatives

Section 2.4.3 presents a description of the six reclamation alternatives developed for the Landusky Mine. Although the alternatives vary in emphasizing certain aspects of reclamation, all alternatives were formulated by the agencies' engineering consultants, under the direction of the technical working group, to meet the applicable regulatory requirements and standards for mine reclamation. The major difference between alternatives is the amount of pit backfill placed in the mine pits. The amount of backfilling required under each alternative determines whether additional mine dumps or spent ore heaps are picked up and placed back into the pits. Another difference in the alternatives is the method of ensuring free draining conditions from the pit complex, with some alternatives using surface drainage and some groundwater discharge.

Alternative L1 is the same reclamation plan as that initially selected in the agencies' June 1998 Record of Decision, and is based on Alternative 3 of the FEIS.

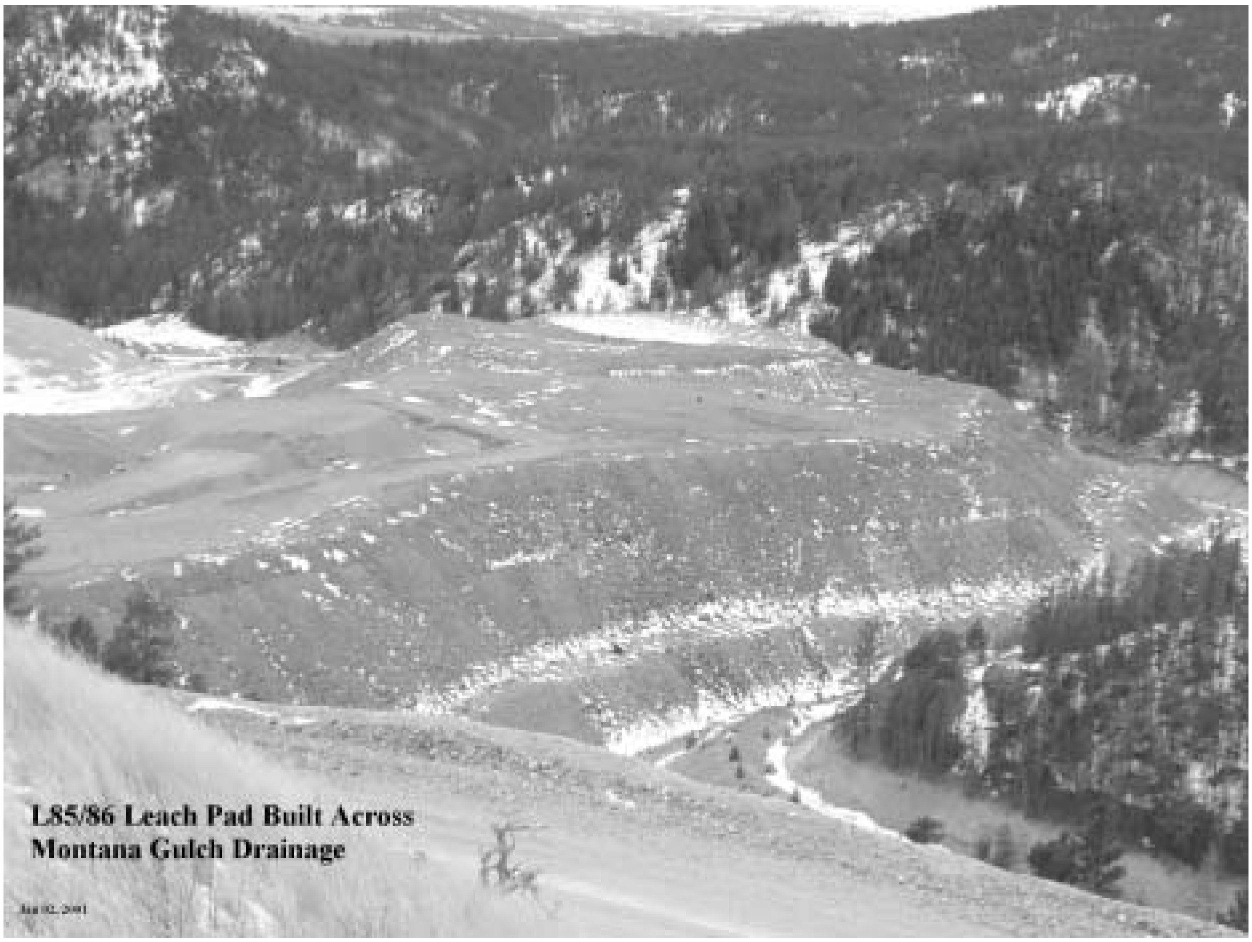
Alternative L2 is designed to be affordable within the existing reclamation bond amount. Leach pad slopes would be regraded, covered with soil, and revegetated. The pit complex would be drained via the existing artesian well. A partial drainage notch would be cut around the west side of the L85/86 leach pad in order to restore drainage to a tributary to Montana Gulch.

Alternative L3 includes all provisions of Alternative L2, plus a few more reclamation features that are beyond the existing reclamation bond amount. The pit complex would be drained via an 8-inch diameter directional drill hole into Montana Gulch. Sulfides exposed in the highwall and upper bench of the Suprise pit would be covered. A full drainage notch would be constructed on the west side of the L85/86 leach pad to eliminate standing water.

Alternative L4 is not restricted by the reclamation bond amounts. The entire L85/86 leach pad and dike would be completely removed from the Montana Gulch drainage. This material would be used to cover highwalls and to partially backfill the August/ Little Ben pit. Sulfides exposed in the highwall and upper bench of the Suprise pit would also be covered using material from the August #2 waste rock dump. The pit complex would be drained via groundwater discharge through the existing artesian well. An 8-inch diameter directional drill hole into Montana Gulch could also be provided as a backup drainage measure. In the Gold Bug pit, highwall reduction would be used to cover pit walls. The L87/91 leach pad would be reclaimed in place with the spent ore regraded to an overall slope of 2.5H:1V.

Alternative L5 includes additional backfill in the pit to cover most of the sulfide highwalls. The L85/86 leach pad and dike, and much of the L87 leach pad spent ore would be removed and used as backfill in the mine pits. A synthetic liner would be installed over the entire floor of the pit complex prior to backfilling. A small notch would be cut through the highwall at the south end of the pit complex to provide drainage from the pit area.

Alternative L6 includes backfilling of the mine pits to restore the pit areas to their approximate pre-mining topography and drainage pattern. The north-south drainage divide would be re-established. All regraded surfaces in the pit area and on the L87/91 leach pad would be covered with low-infiltration water barrier or water balance reclamation covers, depending on slope steepness. Prior to backfill, low permeability liners would be installed over the pit floors in the August/Little Ben/Suprise/Queen Rose pit complex.



Reclamation Common Among Landusky Mine Alternatives

Water Management

This section presents an overview of water management plans at the Landusky Mine which would occur under all alternatives to mitigate water quality impacts from mine facility discharges. It includes a description of measures that have been implemented for management of process waters, stormwaters and mine drainage. This section is divided into discussions on surface water runoff control, water capture, water treatment, land application disposal and monitoring.

Surface Water Runoff Control

The Gold Bug, Queen Rose and Suprise pits would be free draining. The pit floors would be sloped to prevent impoundment of runoff in the pit. Currently, water which infiltrates through the August/Little Ben pit area enters the groundwater system and reports to the artesian well designated WS3. This flow is then routed to the Landusky Mine water treatment plant where it is treated and discharged to Montana Gulch. Options for routing runoff through the August/Little Ben pit area are developed in the alternatives.

Historic mine tailings downstream from the Landusky Mine in King Creek have been removed and the channel rehabilitated. The tailings have been placed as reclamation cover material on the L80-82, L83, and L84 leach pads. This action took place during the summer of 2000 as part of an EPA removal action.

Water Capture

The water capture structures in upper Montana Gulch, lower Montana Gulch, Mill Gulch, and Sullivan Gulch would remain as long as seepage capture is needed to protect water quality. These capture systems would be upgraded as necessary under all reclamation alternatives so that downstream water quality meets the requirements of the MPDES permit. Seepage capture systems and semi-passive treatment systems may be placed in King Creek and Swift Gulch, depending upon future monitoring results and feasibility studies.

Water Treatment

ZMI constructed the water treatment plant at the Landusky Mine in 1997 to treat water discharging from the old underground mine workings and the seepage capture system returns. The plant treats around 22 million gallons per month on a 24-hour per day, 7-day per week basis. Interim effluent discharge standards for the water treatment plant were established under the 1996 Consent Decree. Establishment of final effluent limits and outfall points would bet set by the MPDES permit (Appendix C). The water treatment plant would continue to operate indefinitely, as long as there is water being captured that requires treatment.

All captured seepage waters are pumped to a pond prior to entering the water treatment plant. This feed pond has a 12.5 million gallon storage capacity. Water is then pumped from the feed pond into the water treatment plant. The plant's metal precipitation process uses hydrated lime. Lime is stored at this plant in a 50-ton storage silo. Approximately 90% of the influent feed water enters the plant's rapid mix tank. Lime is added to the lime/sludge tank where it is mixed and routed to the rapid mix tank. Flow is routed to a launder in the top of the oxidation tank before it enters the clarifier. The oxidation tank is a 47,000 gallon, 20-foot diameter, 20-foot high steel tank originally designed to oxidize solid ferric iron to ferrous iron as a flocculant. This tank is currently bypassed and only its effluent launder is in use. The clarifier is a 178,500 gallon tank, 45 feet in diameter and 15 feet high. It is fed lime from the silo into the batch tank which is level controlled and automatically refilled daily. The lime solution is then fed using a timed slurry pump with a bypass back to the lime batch tank. The pH set point in the clarifier is 8.6. Treated effluent is routed from the clarifier to a pond then discharged into Montana Gulch. A pond bypass line can direct the effluent to another holding pond should plant effluent not meet discharge limits.

Leach Pad Water Land Application Disposal

Water drained from the leach pads at the Landusky Mine would continue to be pumped to the Z82 pond at the Zortman Mine for treatment with hydrogen peroxide to detoxify residual cyanide. It then enters the pipeline for transport to Goslin Flats where the pad water is land applied. All solutions must be at or below 0.22 mg/l WAD cyanide prior to land application. Operation of the Goslin Flats land application area is described in Section 2.4.1, Leach Pad Water Land Application Disposal, as part of the reclamation actions common to both mines. Pre-treatment of pad water using the bioreactor is common to all alternatives.

Water Resources Monitoring

The monitoring program for surface and ground water would continue as required under the Consent Decree until replaced by the MPDES permit. The monitoring program containing the requirements of the Consent Decree, MPDES permit (Appendix C), and mine operating plans would be implemented.

Reclamation Materials

Reclamation materials would be required for construction of the reclamation covers and the runoff drains and diversions. The primary materials that would be used are cover soil, non-acid generating rock, rock amended with lime, limestone quarried on site, and the King Creek tailings. The water barrier covers would incorporate a geosynthetic clay liner or synthetic membrane liner to restrict water infiltration.

Tailings

The King Creek tailings, excavated as part of a removal action by EPA, are suitable as reclamation cover material. Approximately 75,000 cubic yards of tailings have been placed on the lower leach pads (L80-82, L83 and L84). This provided a 6-inch thick layer of tailings over the regraded leach pad surface.

Limestone/Dolomite

Limestone from existing stockpiles would be used to line drainages where durable material was required. Under some of the alternatives, such as L1, limestone would be quarried from adjacent areas for use in reclamation.

Soil

Soil salvaged during mine construction and operation would be applied over the regraded mine disturbances as the final 12- to 24-inch lift on the reclamation covers. Soil for reclamation at the Landusky Mine would be obtained from one of four stockpiles: the Montana Gulch soil stockpile, Gold Bug soil stockpile, August/Little Ben soil stockpile, or Mill Gulch soil stockpile. The approximate total volume of soil available in these stockpiles is 1,780,000 cubic yards.

Based on the estimated amounts in the soil stockpiles, there appears to be more than adequate soil stockpiled at the Landusky Mine to construct the various alternative reclamation covers. Excess soil from the Landusky Mine stockpiles would then be used to supplement the limited supply of soil available at the Zortman Mine.

Support Facilities Reclamation

All cement structure footings and pads would be removed and used to help backfill depressions or openings such as ponds, or would be disposed of as solid waste. The footprint of mine facilities that have been removed would be covered with 12 inches of soil and revegetated.

Access and Haul Road Reclamation/Relocation

All alternatives would leave post-reclamation access roads between the Zortman and Landusky Mines over Antoine Butte. The access roads from the Landusky Mine to the communities of Hays and Landusky would remain in place, although their use may be restricted. Roads would also be left to provide access to the water treatment plants and the seepage capture systems.

Gold Bug Waste Repository

The Gold Bug repository was designed to hold acid generating waste rock. Construction began in 1993 with plans to ultimately contain 21.7 million tons of waste. However, only the first stage of construction (11 million tons) and a small portion of the second phase were completed before the mine ceased operation in 1996. The repository is estimated to contain a total of 13.4 million tons of waste. This quantity includes the lower Gold Bug blue waste stockpile, which was constructed in the southeast corner of the facility over the lower repository fill, and the upper Gold Bug blue waste stockpile.

The first stage of construction was designed to bring the top of the facility up to an elevation of 4900 feet. The base of the facility was constructed by placing a 3-foot deep layer of limestone and dolomite across the 4640 bench of the pit. An additional 100 tons of lime was distributed over the portion of the base that was in contact with the main Gold Bug shear. Above this base layer, the more sulfidic “green” waste materials were selectively placed toward the interior of the facility. The margins were filled with “yellow” wastes having an average net neutralization potential of near zero. At the 4740 level, a 6-inch barrier was installed to separate the upper repository from the lower repository. This layer was inclined with a 2% grade that was contoured to direct leachate to the southwest. A collection trough was constructed to convey these fluids to the repository toe at the southern end of the repository, where they can be collected.

Slopes on the completed portion of the repository were reclaimed by placing a 6-inch layer of compacted clay over the graded yellow waste along the outside of the facility. The clay barrier was covered with 2 to 18 inches of run-of-mine “blue” (non-acid generating) waste, which was intended to function as a capillary break. A final cover of 12 inches of soil was then placed over the layer of blue waste.

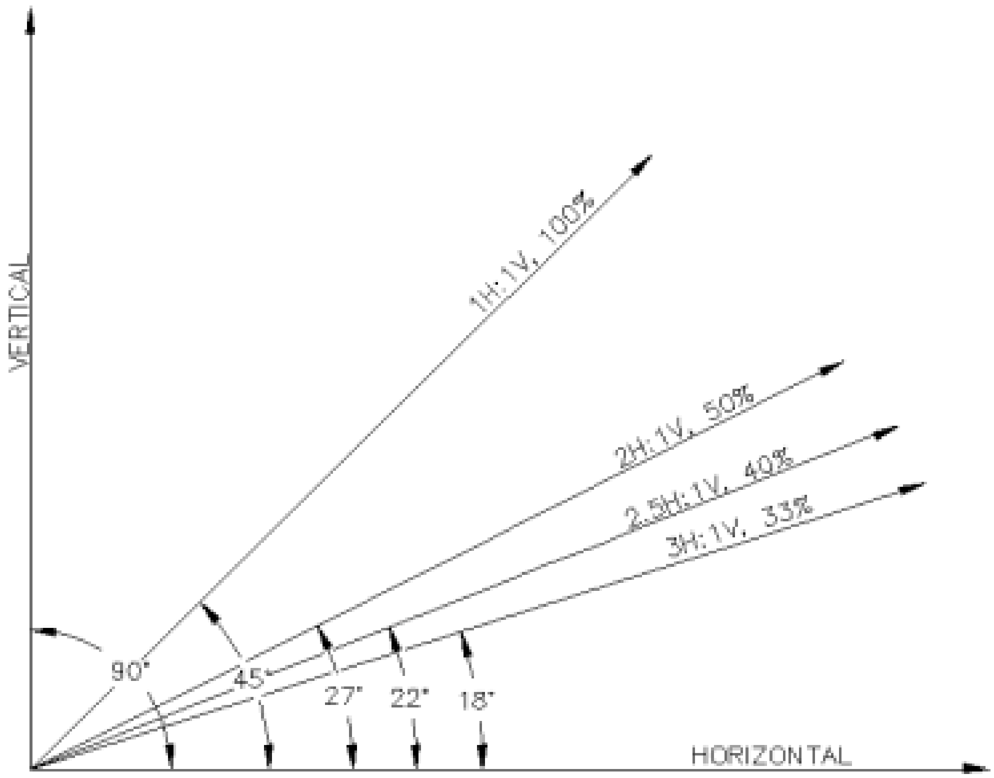
Drainage off the main repository face was controlled by constructing benches every 100 vertical feet (200 horizontal feet). The benches were from 15 to 30 feet wide and sloped back into the repository at grades of 5 to 10%. The benches were also capped with clay. A drainage ditch, with an impermeable synthetic liner held in place by 6 inches of blue waste material, was constructed along the toe of the facility.

Landusky Mine Interim Reclamation

Interim reclamation work at the Landusky Mine includes: regrading, placement of soil and planting on the L80-82, L83 and L84 leach pads; cutting a drainage notch around the L85/86 leach pad; regrading the Gold Bug pit complex; extending the liner on the east side of the L91 leach pad and regrading that side of the heap; building out the L84 dike and contouring the slope southeast of the L84 dike; reducing the highwall at the north end of the Gold Bug pit by blasting; backfilling the Suprise and Queen Rose pits to establish positive drainage; installing a GCL liner over the backfill on the Suprise and Queen Rose pit floors; and regrading the August #1 waste rock dump to cover adjacent pit benches. This work is ongoing and will extend into 2002.

In addition, other reclamation work completed in 2000 includes integrating the EPA removal of the tailings from King Creek with the interim mine reclamation work. The tailings excavated from King Creek were placed on the L80-82, L83 and L84 leach pads as part of the reclamation cover, instead of being transported to an off-site waste repository for disposal. This action saved money for both the King Creek removal action and the Landusky Mine reclamation, while providing needed reclamation resources for construction of the leach pad reclamation covers. Other interim reclamation work conducted in 2000 included cleanup and removal of old mining equipment and supplies.

The following diagram shows the relationship between reclamation slopes, grades, and the angle from the horizontal. This diagram is useful when reading the alternative descriptions. Reclamation slopes are commonly described as a ratio of the horizontal measurement to the vertical measurement, expressed as H:V. For example, a slope described as 2H:1V, would change by 1 foot in elevation every 2 feet of horizontal distance.



Alternative L1, 1998 ROD Reclamation

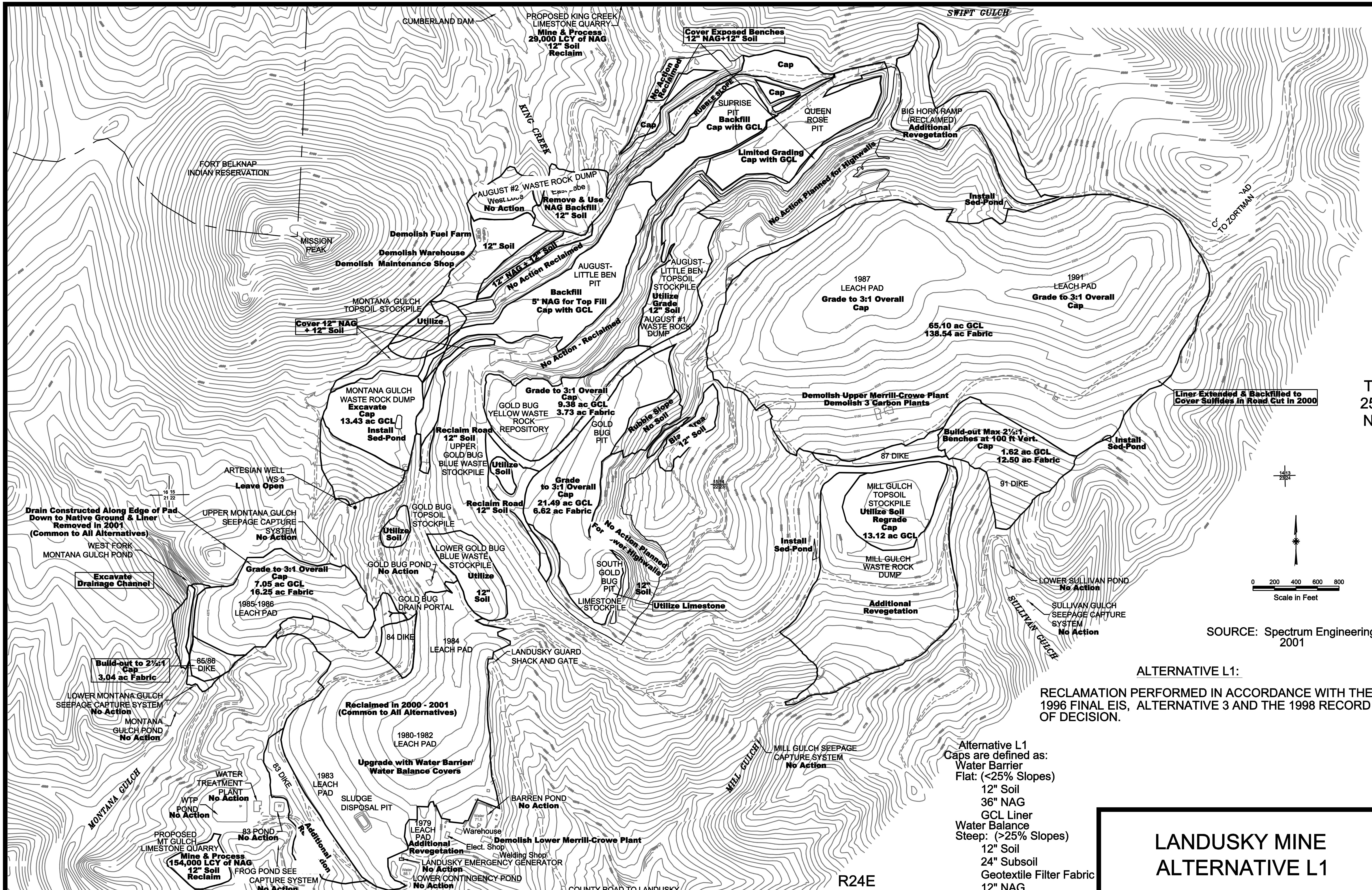
Alternative L1 would implement the reclamation described under Alternative 3 of the FEIS, as modified by the June 1998 ROD. The reclamation cost for this alternative would exceed the existing reclamation bond amount. The major cost items include placement of geosynthetic liner or geotextile fabric as part of the respective water barrier or water balance covers, construction of the pit drainage notch, and leach pad water management. See Section 4.12 for reclamation cost details and a description of this alternative's impact on reclamation costs. The reclamation action for each mine feature is shown in Figure 2.4-9. Those mine features that would be considered reclaimed, and not receiving additional reclamation work under this alternative, are marked "No Action."

Mine Pit Reclamation

August/Little Ben-Suprise Pit Complex

The August/Little Ben pit is located on the ridge dividing the Montana Gulch and King Creek drainages. The northeast end of this pit extends into the Suprise pit, which straddles the divide between King Creek and Swift Gulch. Sulfide minerals are exposed in the lower portions of most of the pit walls. The pit highwalls are broken by randomly spaced benches of various configurations. Some of these benches have been covered with reclamation covers and reclaimed. Some of the smaller benches are no longer accessible (see also, aerial photos in Appendix D, 1995 Draft EIS).

The August/Little Ben pit was excavated to a depth of 4645 feet amsl. The floor of the Suprise pit is at an elevation of 4740 feet amsl. These elevations are at least 100 feet below the lowest rim of the pit. Consequently, precipitation around the pit complex tends to collect on the pit floor. Interim reclamation work in 2001 provided backfill, grading, and a GCL liner in the Suprise and Queen Rose pits to prevent water from collecting at the north end of the pit complex. All precipitation runs down the pit floor to the August/Little Ben pit. From there, the runoff either evaporates or infiltrates into the underground mine workings below the pit floor. Water collecting in these underground workings used to drain out through a drain tunnel located in Montana Gulch. However, the tunnel is now blocked and its portal is buried beneath the Montana Gulch waste rock dump. Although the drain tunnel is blocked, there is still a connection between the underground workings and artesian well WS3. Water levels in the pit can be controlled by opening and closing this well. Discharge from the well is captured by the upper Montana Gulch capture system and treated in the water treatment plant. The pit can be kept drained by leaving the well unplugged. In order to prevent impoundment of runoff within the pit and to reduce the potential for acid drainage, a drainage notch would be excavated through the pit wall on the southwest end of the August/Little Ben pit to Montana Gulch.



LANDUSKY MINE
ALTERNATIVE L1
ALTERNATIVE L1:
RECLAMATION PERFORMED IN ACCORDANCE WITH THE 1996 FINAL EIS, ALTERNATIVE 3 AND THE 1998 RECORD OF DECISION.
Alternative L1
Caps are defined as:
Water Barrier
Flat: (<25% Slopes)
12" Soil
36" NAG
GCL Liner
Water Balance
Steep: (>25% Slopes)
12" Soil
24" Subsoil
Geotextile Filter Fabric
12" NAG
SOURCE: Spectrum Engineering 2001
0 200 400 600 800
Scale in Feet
T 25 N
R24E
SWIFT GULCH
KING CREEK
MONTANA GULCH
MILL GULCH
SULLIVAN GULCH
CUMBERLAND DAM
PROPOSED KING CREEK LIMESTONE QUARRY
Mine & Process 29,000 LCY of NAG
12" Soil
Reclaim
Cover Exposed Benches 12" NAG+12" Soil
No Action Reclaimed
Rubble Slope
Cap
SUPRISE PIT
Backfill
Cap with GCL
QUEEN ROSE PIT
Limited Grading
Cap with GCL
BIG HORN RAMP (RECLAIMED)
Additional Revegetation
No Action Planned for Highwalls
Install Sed-Pond
TO ZORTMAN
FORT BELKNAP INDIAN RESERVATION
MISSION PEAK
AUGUST #2 WASTE ROCK DUMP
West Lobe
No Action
East Lobe
Remove & Use NAG Backfill
12" Soil
Demolish Fuel Farm
12" Soil
Demolish Warehouse
Demolish Maintenance Shop
12" NAG + 12" Soil
No Action Reclaimed
AUGUST-LITTLE BEN PIT
Backfill
5' NAG for Top Fill
Cap with GCL
AUGUST-LITTLE BEN TOPSOIL STOCKPILE
Utilize
Grade
12" Soil
AUGUST #1 WASTE ROCK DUMP
1987 LEACH PAD
Grade to 3:1 Overall
Cap
1991 LEACH PAD
Grade to 3:1 Overall
Cap
65.10 ac GCL
138.54 ac Fabric
MONTANA GULCH TOPSOIL STOCKPILE
Utilize
Cover 12" NAG + 12" Soil
No Action - Reclaimed
MONTANA GULCH WASTE ROCK DUMP
Excavate
Cap
13.43 ac GCL
Install Sed-Pond
GOLD BUG YELLOW WASTE ROCK REPOSITORY
Grade to 3:1 Overall
Cap
9.38 ac GCL
3.73 ac Fabric
Reclaim Road
12" Soil
UPPER GOLD BUG BLUE WASTE STOCKPILE
Utilize Soil
GOLD BUG PIT
Rubble Slope No Soil
Blast Area 12" Soil
Demolish Upper Merrill-Crowe Plant
Demolish 3 Carbon Plants
Liner Extended & Backfilled to Cover Sulfides in Road Cut in 2000
Build-out Max 2½:1 Benches at 100 ft Vert.
Cap
1.62 ac GCL
12.50 ac Fabric
Install Sed-Pond
87 DIKE
91 DIKE
ARTESIAN WELL WS 3
Leave Open
Reclaim Road
12" Soil
Grade to 3:1 Overall
Cap
21.49 ac GCL
6.62 ac Fabric
No Action Planned For Lower Highwalls
MILL GULCH TOPSOIL STOCKPILE
Utilize Soil
Regrade
Cap
13.12 ac GCL
Install Sed-Pond
Drain Constructed Along Edge of Pad Down to Native Ground & Liner Removed in 2001 (Common to All Alternatives)
UPPER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
GOLD BUG TOPSOIL STOCKPILE
Utilize Soil
WEST FORK MONTANA GULCH POND
LOWER GOLD BUG BLUE WASTE STOCKPILE
Utilize
12" Soil
SOUTH GOLD BUG PIT
12" Soil
MILL GULCH WASTE ROCK DUMP
LOWER SULLIVAN POND
No Action
Excavate Drainage Channel
Grade to 3:1 Overall
Cap
7.05 ac GCL
16.25 ac Fabric
GOLD BUG POND
No Action
1985-1986 LEACH PAD
GOLD BUG DRAIN PORTAL
LIMESTONE STOCKPILE
Utilize Limestone
Additional Revegetation
SULLIVAN GULCH SEEPAGE CAPTURE SYSTEM
No Action
84 DIKE
1984 LEACH PAD
LANDUSKY GUARD SHACK AND GATE
Build-out to 2½:1
Cap
3.04 ac Fabric
85/86 DIKE
LOWER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
MONTANA GULCH POND
No Action
Reclaimed in 2000 - 2001 (Common to All Alternatives)
1980-1982 LEACH PAD
Upgrade with Water Barrier/ Water Balance Covers
MILL GULCH SEEPAGE CAPTURE SYSTEM
No Action
WATER TREATMENT PLANT
No Action
WTP POND
No Action
83 DIKE
1983 LEACH PAD
SLUDGE DISPOSAL PIT
BARREN POND
No Action
PROPOSED MT GULCH LIMESTONE QUARRY
Mine & Process 154,000 LCY of NAG
12" Soil
Reclaim
83 POND
No Action
Additional Revegetation
1979 LEACH PAD
Warehouse
Demolish Lower Merrill-Crowe Plant
Elect. Shop
Welding Shop
LANDUSKY EMERGENCY GENERATOR
No Action
FROG POND SEEPAGE CAPTURE SYSTEM
No Action
LOWER CONTINGENCY POND
No Action
COUNTY ROAD TO LANDUSKY

FIGURE 2.4-9

The excavation would cut through the bedrock wall of the pit and continue through the upper lift of the Montana Gulch waste rock dump. Because the size of the notch is controlled by its bottom elevation, all materials removed during construction of the notch would be backfilled into the pit to raise the drainage elevation. Therefore, notch construction would balance excavation and backfill quantities.

The pit complex would be backfilled to a minimum elevation of 4740 feet amsl, as measured at the southwest end of the August pit, to create a surface that would drain freely through the notch and into Montana Gulch. Backfill within the pit complex would be sloped at approximately 2-3% all the way back to the end of the Suprise pit. The 2-3% gradient would also be maintained through the notch and along the channel cut across the Montana Gulch waste rock dump. The backfill design within the August/Little Ben pit would insure that only non-acid generating material would be placed in the top 5 feet of the fill.

An estimated 2,933,000 cubic yards of excavation and backfill would be used to construct the drainage notch and regrade the bottom of the pit. Because 1,486,000 cubic yards of this total would be excavated from the Montana Gulch waste rock dump, the width of the notch would have to be wide enough to accommodate a haul road. In those areas where the excavation would cut through bedrock, the walls of the notch would be left as steep as the walls in the rest of the pit. Benching would provide stability. In unconsolidated areas of the notch, the side slopes would be graded to 3H:1V.

The channel constructed through the pit floor and out the drainage notch would be sized to accommodate the runoff from a 6.33-inch, 24-hour storm event. After passing though the notch and traveling through a channel cut along the east side of the Montana Gulch waste rock dump, runoff from the pit would follow a lined channel which has been built along an old haul road on the east slope of the Montana Gulch drainage. The channel follows the road around the L85/86 leach pad. During reclamation of the L85/86 leach pad, several sections of this channel would be reconstructed. The channel would also be extended to provide for discharge into a drainage downstream of the L85/86 dike. A sediment pond would be constructed on the Montana Gulch waste rock dump to remove sediment from the runoff before it enters the lined channel.

In order to limit infiltration of precipitation through the backfill material placed in the pit, a water barrier reclamation cover would be placed over the graded surface of the backfill. The relatively flat area would be covered with a 4-foot thick cover consisting of a geosynthetic liner, 36 inches of NAG, and 12 inches of soil. Because there are exposed sulfides on the benches on the north and west sides of the Suprise pit, the narrow benches and pit wall below the elevation of 4875 feet amsl would also be covered with NAG backfill. Water barrier covers would be used to cover the benches above this elevation. A bench cover consisting of 12 inches of NAG and 12 inches of soil would be placed over 16.8 acres of pit benches around the August/Little Ben pit. Approximately 61.5 acres would be covered and revegetated.

Queen Rose Pit

The Queen Rose pit is an upper bench extension of the August/Little Ben-Suprise pit complex. It is situated on the southeast side of the Suprise pit, with its floor at an elevation of 4825 feet amsl. A haul road ramps up the 75-foot highwall between the two pits. On the opposite side of the pit, the pit wall extends up nearly 400 feet vertically to the road running along the base of the L87 leach pad.

The pit floor would be backfilled and graded to drain freely into the partially backfilled Suprise pit. This relatively flat 16.8-acre bench would be covered with a 4-foot thick water barrier cover consisting of a geosynthetic liner, 36 inches of NAG, and 12 inches of soil. A bench cover consisting of 12 inches of NAG and 12 inches of soil would be placed over 3.5 acres of narrow pit benches that are still accessible around this pit. Approximately 20.3 acres would be covered and revegetated.

Gold Bug and South Gold Bug Pits

The Gold Bug pit was excavated at the head of the King Creek drainage. It is situated above and to the south of the August/Little Ben pit. Prior to 1993, the bottommost bench at the south end of the pit extended down to an elevation of 4650 feet amsl. However, between 1993 and 1996, much of the pit was turned into a repository for potentially acid generating waste rock. Construction of this facility is presented under Reclamation Common Among Landusky Mine Alternatives. Approximately 13.4 million tons of waste rock was placed into the facility before the mine ceased operation. As the fill in the repository was raised up to its current mean elevation of 5055 feet amsl, a large area on the face of the dump was graded, sealed with a layer of compacted clay, and covered with NAG and soil. Along the east side of the repository, the original pit walls extend up to the crest of the ridge, which is at 5400 feet amsl. A zone containing sulfide rock reaches about halfway up the exposed portion of the pit wall.

During 2001 interim reclamation, the fill in the unreclaimed portion of the pit was graded to slopes of 3H:1V or flatter. All depressions and benches were eliminated to produce a free draining surface. In addition, a 700-foot long section of highwall at the north end of the Gold Bug pit would be blasted to lower the top of the wall by about 50 feet. The blast material would be pushed into the pit, producing a rubble slope that extends up the face of the highwall.

The South Gold Bug pit is a southerly extension of the Gold Bug pit that wraps around the ridge into the Montana Gulch drainage. The South Gold Bug section of the pit complex contains some lower benches that bring the floor down to an elevation of 4925 feet amsl. During the later stages of the mining operation this area of the pit was used to stockpile limestone. After the limestone stockpile has been removed and utilized either as NAG cover or NAG fill, the lower benches on the west side of the pits would be reduced to 3H:1V slopes, producing a free draining surface.

In order to limit infiltration of precipitation through the backfill in the regraded area of the pit complex, an area containing approximately 28.1 acres would be covered with a combination of a 21.5-acre water barrier and a 6.6-acre water balance cover, and revegetated. These reclamation covers are each four feet thick. An additional one-half acre of accessible bench on the east side of the South Gold Bug pit would be covered with 12 inches of NAG, 12 inches of soil, and revegetated. The highwall reduction source area, which covers about 3.6 acres, would be covered with 12 inches of soil and revegetated.

Leach Pad Reclamation

All spent ore heaps would be recontoured to provide a topography that blends into the surrounding landscape. The leach pads would be reclaimed in place, with some redistribution of the spent ore onto the associated dikes and areas adjacent the leach pads. Surfaces would be graded to reduce pad slopes to an overall 3H:1V slope to stabilize cover soil, enhance the potential for successful revegetation and limit surface water infiltration. Benches would be constructed every 100 vertical feet. Slope reduction would be performed in part by bulldozers pushing ore heap material from the top of the heap down over the lift slopes. Where the desired grades could not be obtained by dozing alone, trucks and loaders would offload the spent ore and redistribute it to fill areas. Leach pad surfaces would be covered with either the water balance or water barrier covers, except for on the L79 leach pad, where the existing reclamation cover would be considered final. Heap retaining dikes requiring reclamation would be reduced to a nominal slope of 2.5H:1V, covered with the water balance covers, and revegetated.

Leach pad drawdown water would continue to be treated and disposed of at Goslin Flats. After 10 years, the leach pad liners would be perforated if it is determined that water quality management objectives would be met. No dewatering of the pads would occur unless the rate of accumulation dictated that dewatering was necessary before the 10-year monitoring period was reached. The liners would be perforated by drilling 3 to 4 drain holes 6 inches in diameter into the underlying drainage system to provide an exit for solution within the heap. Each perforated drain hole would be backfilled with drain rock to an elevation of at least 5 feet above the liner surface to ensure continued drainage. The drain holes would be positioned at the lowest elevation in the pad collection basin to provide for adequate drainage and to prevent the formation of undesirable hydraulic conditions within the heap.

L79 Leach Pad

The L79 Pad is part of the complex of leach pads located near the lower Merrill-Crowe plant at the southwest corner of the mine. This leach pad was reclaimed with 8 to 12 inches of soil and revegetated in September 1991. Additional planting and fertilization would be done to enhance the existing vegetation.

L80-82, L83, and L84 Leach Pads

The L80-82, L83, and L84 leach pads make up the remainder of the complex of leach pads located near the lower Merrill-Crowe plant at the southwest corner of the mine. They are all on their own individual liners, although some share common containment dikes and collection facilities. This complex of spent ore heaps contains about 5,526,000 cubic yards of material.

These leach pads were regraded as part of the 2000 interim reclamation. Approximately 1.1 million cubic yards of grading and excavation were conducted to recontour these heaps to overall grades of less than 3H:1V. Because the pads were reduced to a height of just over 100 feet, benching was not needed. The regrading included some offloading of the spent ore onto unlined and partially lined areas adjacent to the pads and included filling several large depressions between the L80-82 and L83 leach pads and extending the backfill over the upper contingency pond and the process water pond.

Interim reclamation also included building out the L84 dike to a 3H:1V slope using material from the L85/86 leach pad. In conjunction with this effort, the over-steepened slope to the south of the dike was also rebuilt using material offloaded from the L80/82 leach pad and the L85/86 leach pad.

The regraded leach pads were covered with an interim reclamation cover consisting of 6 inches of King Creek tailings and 18 inches of soil over 24 inches of NAG. They were revegetated in 2001. The interim reclamation would be removed and the water barrier and water balance reclamation covers would be placed on the regraded surface. The L84 dike and adjacent slope reclamation would be covered with 24 inches of soil and seeded. Existing reclamation on the L83 dike would be improved with additional fertilization, seeding and planting.

L85/86 Leach Pad

The L85/86 leach pad, containing 3,264,000 cubic yards of spent ore, was constructed in the bottom of Montana Gulch. Consequently, it blocks normal drainage along the main channel and from several tributaries near the head of the gulch. The lower Montana Gulch seepage capture system and pond are just downstream of the containment dike. The upper Montana Gulch seepage capture system is directly upstream of the leach pad and downstream of the Montana Gulch waste rock dump. Underdrains are used to convey runoff beneath this leach pad.

Interim reclamation work would offload approximately 443,000 cubic yards of the spent ore to the L84 dike and slope buildout areas. A drainage channel would be constructed along the west margin of the L85/86 leach pad to unblock surface water drainage and eliminate the West Fork Montana Gulch pond. An estimated 113,800 bank cubic yards of excavation along the adjacent hillside would be required to re-establish a free draining channel. This channel would connect into an existing lined channel which bypasses the capture system. The material generated by this excavation would be used as NAG fill and NAG cover on the L85/86 and L91 dikes, and in the Gold Bug pit.

The reclamation grading would pull back the north edge of the leach pad to partially re-establish drainage from the upper end of the gulch. The entire leach pad would be regraded to 3H:1V overall, with benches constructed at 100-foot intervals. Because the pad was constructed in a constrained area, the amount of slope reduction that can be achieved by dozing is limited to about 80,000 cubic yards. The remaining material would be moved by hauling the material off the pad in trucks. This material would be moved to the northeast end of the pad where it would be placed in the gap between the upper edge of the leach pad and the hillside. A large portion of the material would be placed off the liner, but runoff passing over or through the fill would still drain toward the lined area.

The entire 27 acres associated with the leach pad regrade would be capped with water barrier (4.84 acres) and water balance (22.1 acres) covers appropriate to slope conditions, and revegetated. Because most of the west side channel would be cut through rock, most of this disturbance would not be revegetated.

The slope on the front of the L85/86 dike would be built out to a 2.5H:1V slope using about 35,000 cubic yards of the material from the channel excavation. After reconstructing the face of this dike, it would be covered with the water balance cover and revegetated.

<u>L87/91 Leach Pad</u>

The L87 leach pad is situated at the head of Mill Gulch. The L91 leach pad is located at the head of Sullivan Gulch. Individual seepage capture systems are located in both drainages downstream of the leach pads. These two heaps are joined together at the top of the ridge that originally separated the two drainages. They form a huge, flat-topped structure that is several hundred feet high. The structure is benched at about 50-foot intervals, creating overall 2H:1V slopes. Not including the associated containment dikes, the L87/91 pad complex covers over 200 acres and contains nearly 64 million cubic yards of spent ore. The upper Merrill-Crowe plant, three carbon plants, and a large pond are located on the L87 pad. Pump facilities are located on the L91 pad. The main access road from the Zortman Mine crosses the leach pad.

The entire pad complex would be regraded to overall 3H:1V slopes with benches spaced every 100 vertical feet. The liner would be extended on the east and west sides of the leach pad to maximize the quantity of spent ore that can be moved downhill to achieve the 3H:1V slope configuration. Reclamation would include the following excavation and haulage:

- 1,816,000 cubic yards of bulldozer grading;
- 1,164,000 cubic yards of truck/loader redistribution; and
- 1,098,000 cubic yards hauled to the L91 dike for buildout.

The regraded surfaces on the leach pads and the L91 dike would be covered with the water barrier and water balance reclamation covers, depending on the slope conditions. The entire L87/91 Pad and L91 dike area, totaling 223 acres, would be revegetated. All of the facilities on the leach pads, except the pumping facilities, would be removed before regrading. The large pond on the top of the L87 Pad would be backfilled during the grading operation.

The L87 dike would be considered to be reclaimed as it is covered by the Mill Gulch waste rock dump. The L91 dike, which is 350 feet high, would be resloped with maximum 2.5H:1V slopes with a bench every 100 vertical feet. All of the resloping would be accomplished by adding fill to the front face of the dike. Most of this material would be obtained by offloading spent ore from the L87 and L91 leach pads. The last 123,000 cubic yards of fill placed on the surface of the dike would be NAG material hauled in from the L85/86 leach pad drainage cut.

Waste Rock Dump Reclamation

Mill Gulch Waste Rock Dump

The Mill Gulch waste rock dump is located in Mill Gulch directly downstream of the L87 leach pad. It contains over 10 million cubic yards of waste rock. The exposed face of the dump was reclaimed between 1993 and 1995 with a water barrier cover (FEIS Figure 2.5-5). The only portion not presently reclaimed is occupied by the Mill Gulch soil stockpile. After all of the soil stored in this facility has been removed from the top of the waste rock dump, the disturbed area would be regraded and the water barrier cover would be extended across the entire top of the bench. The existing vegetation on the face of the dump would be improved with additional fertilization, seeding and planting.

Montana Gulch Waste Rock Dump

The Montana Gulch waste rock dump is located at the head of Montana Gulch. It contains approximately 5,174,000 cubic yards of waste rock. The front face of the rock dump was reclaimed between September 1989 and April 1990. A truck ready-line still covers a large area on top of this dump, while the back edge is covered by the Montana Gulch soil stockpile.

The soil stockpile and truck ready-line would be removed from the top of the rock dump before construction of the August/Little Ben drainage notch. In order for the pit complex to drain into a lined channel, approximately 1,486,000 cubic yards of material would be excavated from the waste rock dump. This rock would be hauled to the August/Little Ben and Suprise pits and used for backfill. Due to the large backfill requirement, nearly the entire upper lift of the dump would be removed exposing the original ground surface in some areas. Where sections of the top lift are left in place, the surfaces would be regraded with very gentle slopes. A channel connecting the drainage notch to an existing lined channel would be constructed along the east edge of the dump and sized to contain the runoff from a 6.33-inch, 24-hour storm event.

After the top lift of the dump has been excavated and regraded, the remaining portion at the top of the dump (about 13.5 acres) would be covered with the water barrier cover. Twelve inches of NAG and 12 inches of soil would be placed where removal of the dump lift had exposed the original ground surface.

August #1 Waste Rock Dump

The August #1 waste rock dump is spread across several of the topmost benches on the south side of the August/Little Ben pit. Because the August/Little Ben soil stockpile was dumped over the top of the waste rock dump, the two piles are mixed together to some degree. They contain a combined total of about 579,000 cubic yards of material.

Material from the two piles would be segregated and used in reclamation of various areas around the Landusky Mine. Enough of the waste dump would be left in place to grade the dump and stockpile areas plus an additional 5 acres of adjacent pit benches to 3H:1V slopes. The bench cover would use about 124,000 cubic yards of stockpile material and 6,000 cubic yards of bench reduction. The pit benches that would be covered are situated on the north side of the stockpile and below it. All 14.8 acres of the stockpile footprint and regraded bench area would be covered with 12 inches of soil and revegetated.

August #2 Waste Rock Dump

The August #2 waste rock dump is located at the head of the King Creek drainage. It is divided into two lobes, with each lobe occupying a fork in the upper reaches of the drainage. The west lobe abuts into the fill where the maintenance shop, warehouse and fuel farm are located. The west lobe has been graded to blend into the natural terrain and has been covered with 8 to 12 inches of soil. Trees were planted on this lobe in April 1990 and again in April 1991. Reclamation on the west lobe would be considered to be final.

The east lobe, containing about 599,000 cubic yards of material, sits on the north wall of the August/Little Ben pit. This lobe was covered with 8 to 12 inches of soil and revegetated in May 1992. The material in this dump is non-acid generating in character. It would be completely removed and utilized for NAG fill and cover. After this dump has been removed, the exposed slopes would be covered with 12 inches of soil and revegetated.

Gold Bug Yellow Waste Rock Repository

The Gold Bug yellow waste rock repository is located on a bench between the Gold Bug pit and the August/Little Ben pit. It is on the east side of Montana Gulch, directly uphill from the Montana Gulch waste rock dump, and contains about 283,000 cubic yards of waste rock. The Gold Bug yellow waste rock repository is a potential acid producer.

The waste rock would be left in its current location and regraded to slopes of 3H:1V or flatter. The water barrier reclamation cover would be placed over 9.38 acres of the regraded surface. The remaining 3.73 acres of the graded waste rock would have steeper slopes and would be covered with the water balance reclamation cover.

Lower Gold Bug Blue Waste Rock Stockpile

The lower Gold Bug blue waste rock stockpile covers an area of about 6.5 acres and contains 202,000 cubic yards of material. It is located on the east side of Montana Gulch in an area below the South Gold Bug pit. The material in this dump is non-acid generating and would be used in construction of the reclamation covers for other mine facilities. The remaining footprint would be covered with 12 inches of soil and revegetated.

Upper Gold Bug Blue Waste Rock Stockpile

The upper Gold Bug blue waste rock stockpile covers an area of about 2.1 acres and contains 27,000 cubic yards of non-acid generating material. It is located on the east side of Montana Gulch on the same bench as the Gold Bug yellow waste rock repository. The material in this dump is non-acid generating and would be used in construction of reclamation covers for other mine facilities. The remaining footprint would be covered with 12 inches of soil and revegetated.

Reclamation Covers

In developing a reclamation cover system for the Landusky Mine, the FEIS assumed that most of the waste rock and spent ore heap facilities contained potentially acid generating materials. As a result, one of the requirements of the FEIS Alternative 3 was to develop reclamation covers that would support revegetation and limit the surface water infiltration that could lead to the formation of acidic leachate. The cover systems included water barrier (for slopes less than 25%) and water balance (for slopes greater than 25%) covers on both mines. The water barrier cover would consist of a geosynthetic clay liner placed over non-acid generating waste (NAG) and overlain by 36 inches of NAG and 12 inches of soil. The water balance cover would consist of a filter fabric (or geotextile) placed on top of 12 inches of NAG waste and overlain by 24 inches of subsoil and 12 inches of soil. Pit benches would be covered with 12 inches of NAG and 12 inches of soil. Additional detail on the reclamation covers is shown in Figure 2.4-2. Information on the predicted performance of the reclamation covers can be found in Appendix B.

Support Facilities Reclamation

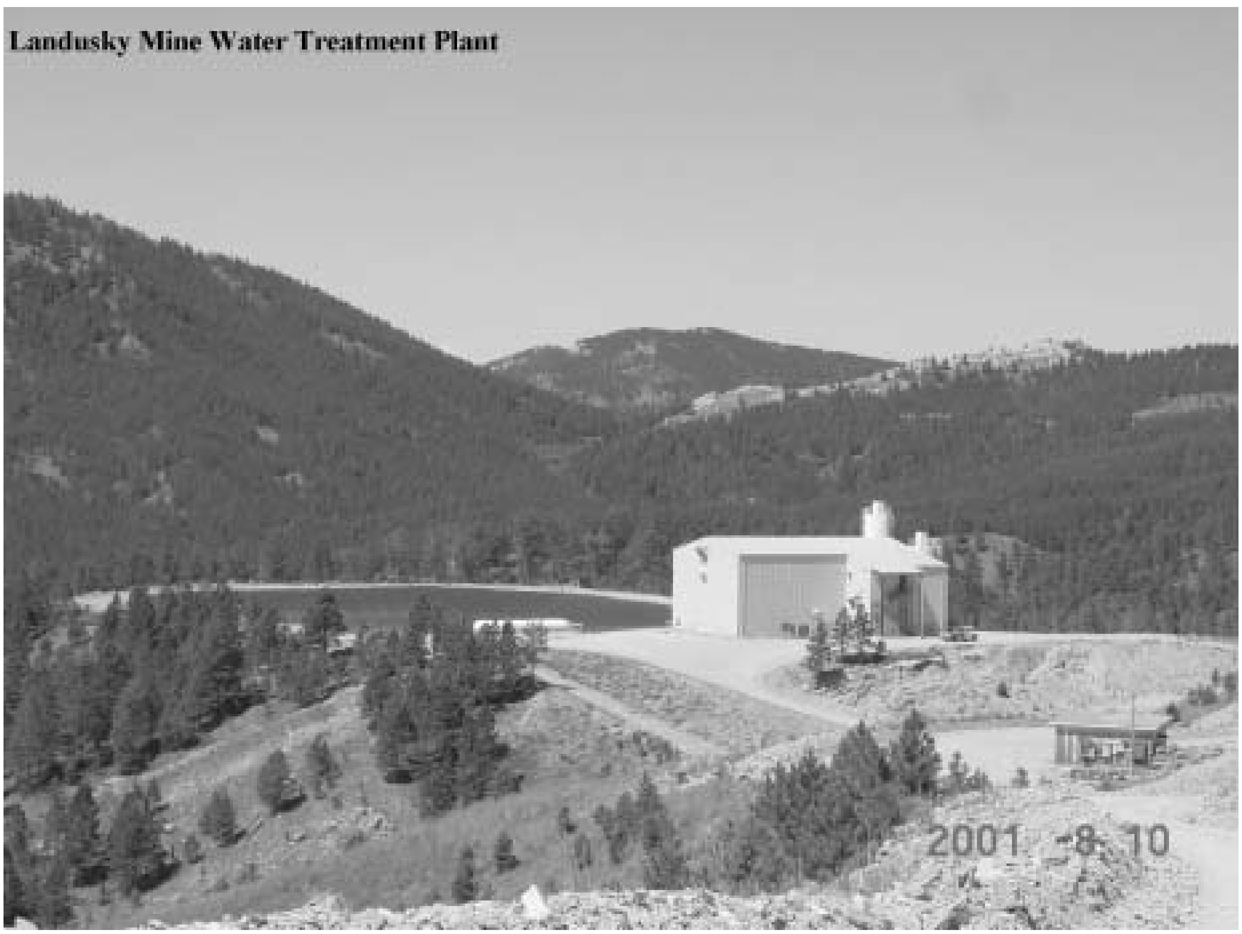
All of the mining-related facilities not associated with water treatment would be removed and their footprints covered with 12 inches of soil and revegetated. These facilities include the fuel farm, upper warehouse, maintenance shop, lower Merrill-Crowe plant, three carbon plants, and the Landusky guard shack and gate. The upper Merrill-Crowe plant would be left for use in the biological treatment process.

The water treatment plant, drainage capture systems, ponds, and associated structures would be left intact and continue functioning where presently located until no longer needed. Once removed, their footprints would be regraded, covered with soil, and revegetated.

Limestone Quarry

This alternative requires more non-acid generating material for reclamation covers and NAG fill than is available in the mine stockpiles. Additional NAG material would be obtained by developing two limestone quarries in the mine area. One quarry with the capacity to supply 154,000 cubic yards of limestone would be developed on a hilltop located southwest of the water treatment plant. The other quarry would be developed in the Damon Hill area in the King Creek watershed.

The two quarries would increase disturbance by about 5 acres. After supplying the necessary quantity of limestone, the disturbed areas would be regraded to 3H:1V slopes. The soil salvaged during the quarry development would be replaced and the area revegetated.



Alternative L2, Optimized Earthwork

Alternative L2 was designed to optimize the amount of earthwork that would be performed within the available bond amount. Waste rock and heap slopes would be regraded, the August/Little Ben pit would be drained via the existing artesian well, and the upper Gold Bug pit highwall would be blasted and used to cover the upper mine benches and sulfides near the pit bottom. A partial drainage notch would be cut around the L85/86 leach pad to restore free drainage around the west side of the leach pad. The reclamation action for each mine feature is shown in Figure 2.4-10. Those mine features that would be considered reclaimed, and not receiving additional reclamation work under this alternative, are marked "No Action" or "Reclaimed in 2000-2001."

Mine Pit Reclamation

August/Little Ben-Suprise Pit Complex

The water level in the pit would be controlled through artesian well WS3. This method of controlling pit drainage has been practiced successfully since October 1999. By using artesian well WS3 to drain the pit, impoundment of water on the pit floor would be eliminated. NAG backfilling, grading, and installation of a GCL liner in the Suprise pit would be done to prevent water from collecting at the north end of the pit complex. NAG backfill would be placed around the north and west sides of the pit to cover exposed sulfides in the pit walls below the elevation of 4875 feet amsl.

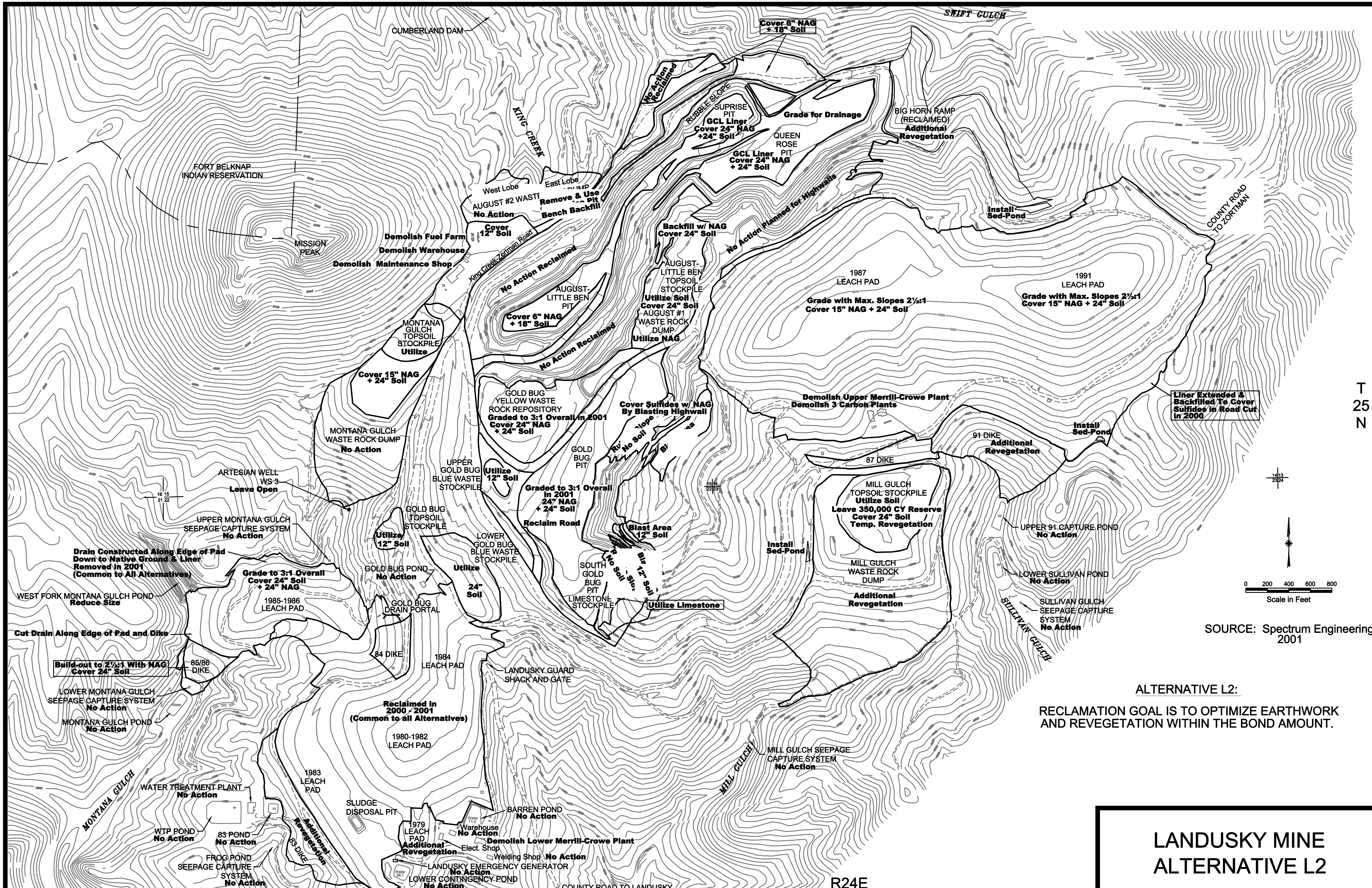
A 6-inch thick layer of NAG would be spread over the remainder of the pit floor and over the lined area in the Suprise pit. The NAG fill would be covered with 18 inches of soil and revegetated. Because there are exposed sulfides on the pit benches of the Suprise pit, these areas would receive the same reclamation cover. About 28.4 acres of pit floor and bench would be revegetated.

Queen Rose Pit

The pit floor would be backfilled and graded to drain freely into the Suprise pit. Reclamation would consist of placing a GCL liner, a 6-inch thick layer of NAG over the liner, covering it with 18 inches of soil, and revegetating. Approximately 15 acres would be covered and revegetated.

Gold Bug and South Gold Bug Pits

In the later stages of the mining operation this pit was partially backfilled and lower sections of the backfilled area were reclaimed. During 2000-2001 interim reclamation, the remainder of the backfilled area would be graded to maximum 3H:1V slopes. All depressions and benches would be eliminated to produce a free draining surface.



LANDUSKY MINE
ALTERNATIVE L2
ALTERNATIVE L2:
RECLAMATION GOAL IS TO OPTIMIZE EARTHWORK AND REVEGETATION WITHIN THE BOND AMOUNT.
SOURCE: Spectrum Engineering 2001
Scale in Feet
0 200 400 600 800
T 25 N
R24E
SWIFT GULCH
CUMBERLAND DAM
KING CREEK
FORT BELKNAP INDIAN RESERVATION
MISSION PEAK
Cover 6" NAG + 18" Soil
No Action Reclaimed
RUBBLE SLOPE
SUPRISE PIT
GCL Liner Cover 24" NAG +24" Soil
Grade for Drainage
QUEEN ROSE PIT
GCL Liner Cover 24" NAG + 24" Soil
BIG HORN RAMP (RECLAIMED)
Additional Revegetation
West Lobe
East Lobe
AUGUST #2 WASTE ROCK DUMP
No Action
Remove & Use Bench Backfill
Cover 12" Soil
Demolish Fuel Farm
Demolish Warehouse
Demolish Maintenance Shop
King Creek-Zortman Road
No Action Reclaimed
Backfill w/ NAG Cover 24" Soil
No Action Planned for Highwalls
Install Sed-Pond
COUNTY ROAD TO ZORTMAN
AUGUST-LITTLE BEN PIT
Cover 6" NAG + 18" Soil
AUGUST-LITTLE BEN TOPSOIL STOCKPILE
Utilize Soil
Cover 24" Soil
AUGUST #1 WASTE ROCK DUMP
Utilize NAG
1987 LEACH PAD
Grade with Max. Slopes 2½:1
Cover 15" NAG + 24" Soil
1991 LEACH PAD
Grade with Max. Slopes 2½:1
Cover 15" NAG + 24" Soil
MONTANA GULCH TOPSOIL STOCKPILE
Utilize
Cover 15" NAG + 24" Soil
No Action Reclaimed
GOLD BUG YELLOW WASTE ROCK REPOSITORY
Graded to 3:1 Overall in 2001
Cover 24" NAG + 24" Soil
Cover Sulfides w/ NAG By Blasting Highwall
No Soil
Demolish Upper Merrill-Crowe Plant
Demolish 3 Carbon Plants
Liner Extended & Backfilled To Cover Sulfides in Road Cut in 2000
Install Sed-Pond
91 DIKE
Additional Revegetation
87 DIKE
MONTANA GULCH WASTE ROCK DUMP
No Action
UPPER GOLD BUG BLUE WASTE STOCKPILE
Utilize 12" Soil
GOLD BUG PIT
Graded to 3:1 Overall in 2001
24" NAG + 24" Soil
Reclaim Road
MILL GULCH TOPSOIL STOCKPILE
Utilize Soil
Leave 350,000 CY Reserve
Cover 24" Soil
Temp. Revegetation
ARTESIAN WELL WS 3
Leave Open
UPPER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
GOLD BUG TOPSOIL STOCKPILE
Utilize 12" Soil
LOWER GOLD BUG BLUE WASTE STOCKPILE
Utilize 24" Soil
Blast Area 12" Soil
SOUTH GOLD BUG PIT
LIMESTONE STOCKPILE
Utilize Limestone
Install Sed-Pond
MILL GULCH WASTE ROCK DUMP
Additional Revegetation
UPPER 91 CAPTURE POND
No Action
LOWER SULLIVAN POND
No Action
SULLIVAN GULCH SEEPAGE CAPTURE SYSTEM
No Action
SULLIVAN GULCH
Drain Constructed Along Edge of Pad Down to Native Ground & Liner Removed in 2001 (Common to All Alternatives)
Grade to 3:1 Overall
Cover 24" Soil + 24" NAG
GOLD BUG POND
No Action
WEST FORK MONTANA GULCH POND
Reduce Size
1985-1986 LEACH PAD
GOLD BUG DRAIN PORTAL
Cut Drain Along Edge of Pad and Dike
84 DIKE
1984 LEACH PAD
Build-out to 2½:1 With NAG Cover 24" Soil
85/86 DIKE
LANDUSKY GUARD SHACK AND GATE
LOWER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
MONTANA GULCH POND
No Action
Reclaimed in 2000 - 2001 (Common to all Alternatives)
1980-1982 LEACH PAD
MILL GULCH SEEPAGE CAPTURE SYSTEM
No Action
MILL GULCH
MONTANA GULCH
WATER TREATMENT PLANT
No Action
1983 LEACH PAD
SLUDGE DISPOSAL PIT
BARREN POND
No Action
WTP POND
No Action
83 POND
No Action
Additional Revegetation
83 DIKE
1979 LEACH PAD
Additional Revegetation
Warehouse
No Action
Demolish Lower Merrill-Crowe Plant
Elect. Shop
Welding Shop
No Action
FROG POND SEEPAGE CAPTURE SYSTEM
No Action
LANDUSKY EMERGENCY GENERATOR
No Action
LOWER CONTINGENCY POND
No Action
COUNTY ROAD TO LANDUSKY

FIGURE 2.4-10

In addition, a 700-foot long section of highwall at the north end of the Gold Bug pit would be blasted to lower the top of the wall by about 50 feet. The blast material would be pushed into the pit, producing a rubble slope that extends up the face of the highwall. This work would involve improving an existing exploration road up to the top of the ridge, stripping soil from 3.58 acres along the ridge top, and then blasting 93,000 bank cubic yards of NAG material in the stripped area. The rubble slope would be left at its angle of repose. The highwall reduction source area at the top of the ridge would be regraded, covered with 12 inches of soil, and revegetated.

After the limestone stockpile in the South Gold Bug pit has been removed and utilized either as NAG cover or NAG fill, the benches on the west side of the pit would be reduced to 3H:1V slopes to produce a free draining surface. The regraded area of the pit complex (approximately 29 acres) would be covered with 24 inches of NAG, 24 inches of soil, and revegetated.

Leach Pad Reclamation

All spent ore heaps would be recontoured to provide a topography that blends into the surrounding landscape. The leach pads would be reclaimed in place with some redistribution of the spent ore onto associated dikes and to areas adjacent the leach pads. All of the pads in the southwest corner of the mine area would be graded to reduce pad slopes to an overall 3H:1V grade. In most cases, there would be no need to incorporate benches into the regrading designs for these relatively low heaps. The L87 and L91 leach pads would be regraded with maximum 2.5H:1V slopes and 25-foot wide benches constructed on 100-foot vertical spacing. Slope reduction would be performed, in part, by bulldozers pushing ore heap material from the top of the facility down over the lift slopes. Where the desired grades could not be obtained by dozing alone, trucks and loaders would be used to offload the material and redistribute it into the fill areas. Depending on the acid generating potential of the material in the heap, leach pad surfaces would be covered with a combination of NAG material and soil. The total cover thickness would vary by pad, between 24 and 48 inches. The reclamation cover would then be revegetated.

Additional reclamation work would be performed on two of the heap retaining dikes, the L85/86 dike and the L84 dike. The L85/86 dike slopes would be built out to a nominal slope of 2.5H:1V. The L84 dike would be built out to a nominal slope of 3H:1V. Since NAG fill would be used in the buildout, the reclamation cover would be limited to 24 inches of soil and the dike faces would be revegetated.

L79 Leach Pad

The L79 Pad is part of the complex of leach pads located near the lower Merrill-Crowe plant at the southwest corner of the mine. This pad has already been reclaimed with 8 to 12 inches of soil and revegetated in September 1991. The existing reclamation would be enhanced with additional fertilization, seeding, and planting.

L80-82, L83, and L84 Leach Pads

Regrading of these leach pads was undertaken as part of the 2000 interim reclamation project. Approximately 1.1 million cubic yards of grading and excavation were conducted to recontour these heaps to final overall grades of less than 3H:1V. Because the pads were reduced to a height of just over 100 feet, benching was not incorporated into the grading plan. The regrading plan required some offloading of the spent ore onto unlined and partially lined areas adjacent to the pads and included filling several large depressions between the L80-82 and L83 leach pads and extending the backfill over the upper contingency pond and the process water pond.

Before applying the interim reclamation cover, the regraded surface was sampled for acid generating potential to a depth of 24 inches on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of King Creek tailings were placed as cover material, followed by 18 inches of soil. The 74-acre surface was seeded in 2001. This interim reclamation would be considered final.

Reclamation on the L83 dike would also be limited to improving the existing vegetation with additional fertilization, seeding, and planting. The L84 dike at the north end of the pad complex has been built out to a 3H:1V slope with about 61,000 cubic yards of material borrowed from the L85/86 leach pad. In conjunction with this effort, the over-steepened slope to the south of the dike would be rebuilt using material offloaded from the L80/82 and L85/86 leach pads. All of the material used in the dike and slope buildout would be NAG. The regraded dike would be covered with 24 inches of soil and revegetated.

L85/86 Leach Pad

The north and west sides of the pad would be reduced to 3H:1V slopes and channels would be constructed around the outside edges to re-establish drainage around the pad. On the north side of the pad, the toe of the heap would be pulled back away from the hillside about 60 feet to allow construction of a channel between the upper Montana Gulch seepage capture system and the West Fork Montana Gulch pond, which is in a tributary drainage plugged by the L85/86 pad. A second channel would be excavated along the west side of the pad and would cut through the northwest corner of the L85/86 dike to convey overflow from the pond into an existing lined channel used to bypass the capture system. Although the west side channel would establish an outlet for the West Fork Montana Gulch pond, it would not eliminate the pond as in Alternative L1, but would reduce the pond's storage elevation by approximately ten feet. Nearly all of the material excavated by slope reduction and channel construction would be used to build out the L84 dike and recontour the disturbed hillside south and west of the dike with 3H:1V slopes.

Alternative L2 incorporates all of the work accomplished by interim reclamation. In addition to this work, contouring on the south and east sides of the pad would be conducted. Relocation of the access roads to the capture system would also be conducted. Final grading of the leach pad would achieve overall 3H:1V slopes in all areas. The relocated road would function as a bench breaking most of the slopes, and no other benches would be constructed.

The amount of slope reduction that could be achieved by dozing is limited to about 77,000 cubic yards. In addition to the material moved during interim reclamation, another 274,000 cubic yards of material would be moved by trucks to the northeast end of the pad, where it would be placed in the gap between the upper edge of the pad and the hillside. A large portion of the material, most of which is non-acid generating, would be placed off the liner but water passing over and through the fill would still drain toward the lined area.

The slope on the front of the L85/86 dike would be built out to a 2.5H:1V slope using about 27,000 cubic yards of the material borrowed from the pad excavation. After reconstructing the face of this dike, it would be covered with 24 inches of soil and revegetated. Approximately 3 acres would be associated with reclamation of the dike.

The pad regrade area would be tested for acid generating potential. Areas requiring neutralization would be amended with lime to insure that 24 inches of NAG would cover the entire area. The entire surface would then be covered with 24 inches of soil and revegetated.

L87/91 Leach Pad

The entire L87/91 leach pad would be regraded with maximum 2.5H:1V slopes with 25-foot wide benches spaced every 100 vertical feet. A 45-foot wide access road would be substituted for one of the benches on the south side of the L91 dike. The liner would be extended on the southeast side of the leach pad to maximize the quantity of spent ore that could be moved downhill to achieve an overall slope configuration of between 2.6H:1V and 3H:1V. The extension of the liner on the southeast side of the L91 leach pad has already been incorporated into the 2000-2001 interim grading plan.

The grading plan would include the following excavation and haulage amounts: 1,884,000 cubic yards of bulldozer grading; and 102,000 cubic yards of truck/loader redistribution. The regraded surface on both leach pads would be covered with 15 inches of NAG and 24 inches of soil. The entire area, totaling 201 acres, would be revegetated. All of the facilities on the leach pads, with the exception of the pumping facilities, would be removed before grading was completed. The large pond on the top of the L87 Pad would be completely backfilled during the grading operation.

The L87 dike is considered to be reclaimed as it is covered by the Mill Gulch waste rock dump. No additional grading would occur on the 350-foot high L91 dike. Buttressing of the dike is not necessary since it is stable in its current configuration (see Section 3.2.2, Geotechnical Conditions). However, the existing vegetation would be improved with additional fertilization, seeding, and planting.

Waste Rock Dump Reclamation

Mill Gulch Waste Rock Dump

The exposed face of the Mill Gulch waste rock dump was reclaimed between 1993 and 1995 (see FEIS Figure 2.5-5). This reclamation would be improved with additional fertilization, seeding, and planting. A reserve soil stockpile of 350,000 cubic yards would be retained on the top of the dump. Additional reclamation would include regrading and seeding the stockpile area.

Montana Gulch Waste Rock Dump

The soil stockpile and truck ready-line would be removed from the top of the Montana Gulch waste rock dump. The top of the dump would then be covered with 15 inches of NAG material and 24 inches of soil. In those areas where removal of the soil stockpile exposed native ground, 12 inches of soil would be placed. About 6.6 acres on the waste rock dump and 6.8 acres of soil stockpile footprint would be revegetated. In other areas of the dump, the existing reclamation would be considered final.

August #1 Waste Rock Dump

The August #1 waste rock dump is spread across several of the topmost benches on the south side of the August/Little Ben pit. Because the August/Little Ben soil stockpile was dumped over the top of the waste rock dump, the two piles are mixed together to some degree.

Material from the two piles would be segregated and used in the reclamation of various areas around the Landusky Mine. Enough of the waste rock dump would be left in place to grade the dump and stockpile areas plus an additional 5 acres of adjacent pit benches to 3H:1V slopes. The bench cover would use about 124,000 cubic yards of stockpile material and 6,000 cubic yards of bench reduction. The pit benches selected for reclamation are on the north side of the stockpile and below it. The 14.8-acre stockpile footprint, and regraded bench area, would be covered with 24 inches of soil and revegetated.

August #2 Waste Rock Dump

The west lobe of the August #2 waste rock dump has been graded to blend into the natural terrain and covered with 8 to 12 inches of soil. Trees were planted on this lobe in April 1990 and again in April 1991. This reclamation on the west lobe would be considered final.

The east lobe, containing about 599,000 cubic yards of material, sits on the north wall of the August/Little Ben pit. This lobe was covered with 8 to 12 inches of soil and revegetated in May 1992. This lobe would be redisturbed for use as a NAG source for reclamation in the Suprise and Queen Rose pits. The disturbed portion of the dump would be regraded, covered with 12 inches of soil, and revegetated.

Gold Bug Yellow Waste Rock Repository

The material in the Gold Bug yellow waste rock repository would be regraded with maximum 3H:1V slopes. The 13.1-acre regraded area would be covered with 24 inches of NAG material, 24 inches of soil, and revegetated.

Lower Gold Bug Blue Waste Rock Stockpile

The material in the lower Gold Bug blue waste rock stockpile is non-acid generating and would be used in construction of the reclamation covers. The remaining footprint would be covered with 24 inches of soil and revegetated.

Upper Gold Bug Blue Waste Rock Stockpile

The material in the upper Gold Bug blue waste rock stockpile has been characterized as non-acid generating and would be used in construction of the reclamation covers. The remaining footprint would be covered with 12 inches of soil and revegetated.

Support Facilities Reclamation

All of the mining-related facilities not associated with water treatment would be removed, their footprints covered with 12 inches of soil, and revegetated. These include the fuel farm, upper warehouse, maintenance shop, lower Merrill-Crowe plant, three carbon plants, and the Landusky guard shack and gate. The upper Merrill-Crowe plant would be left for use in the biological treatment process.

The water treatment plant, drainage capture systems, ponds, and associated structures would be left intact and continue functioning at their present location until no longer needed. Once removed, their footprints would be regraded, covered with soil, and revegetated.

Alternative L3, Improved Pit Drainage

Alternative L3 was designed to include all of the Alternative L2 reclamation measures plus the following additional actions to improve reclamation performance. This alternative slightly exceeds the funding available from the reclamation bond. The August/Little Ben pit would be drained via an 8-inch diameter directional drill hole, in addition to artesian well WS3. The entire east lobe of the August #2 waste rock dump would be removed and used to cover sulfide highwalls in the Suprise pit. A full drainage notch would be constructed on the west side of the L85/86 leach pad to eliminate any impoundment of water behind the leach pad. The reclamation action for each mine feature is shown in Figure 2.4-11. Those mine features that would be considered reclaimed, and not receiving additional reclamation work under this alternative, are marked "No Action" or "Reclaimed in 2000-2001."

Mine Pit Reclamation

<u>August/Little Ben-Suprise Pit Complex</u>

The water level in the August/Little Ben pit would be controlled through artesian well WS3. This method of controlling pit drainage has been practiced successfully since October 1999. By using artesian well WS3 to drain the pit, impoundment of water on the pit floor has been eliminated. In order to reduce the resultant risk if artesian well WS3 eventually plugs, silts in, or otherwise ceases to function, a backup drain would be installed. A directional, angled drill hole 2500 feet long would be drilled to run from the bottom of the August/Little Ben pit into Montana Gulch. This hole would be cased with an 8-inch HDPE SDR11 pipe. Around the inlet, a catchment basin would be constructed to collect ponded water. A spillway would be constructed on the outlet end of the pipe. This pipe would only function or flow if the water level rose to the elevation of the bottom of the pit. Artesian well WS3 would continue to function as the primary drainage control for the pit area.

In order to direct runoff out of the Suprise pit, backfill would be placed on the pit floor to establish a 3% grade. The graded fill would be covered with a GCL liner to minimize water infiltration through the fill. Exposed sulfides in the northern pit highwalls and pit benches of the Suprise pit would be covered with NAG from the east lobe of the August #2 waste rock dump (about 599,000 cubic yards). This material would be end-dumped over the highwall, creating a rubble slope at the angle of repose (approximately 1.3 to 1.4H:1V). The pit benches would be covered with 36 to 72 inches of NAG as part of the backfill operation, followed by 12 inches of soil, and revegetated.

Reclamation inside the pit would consist of placing a 6-inch thick layer of NAG over the liner in the Suprise pit and directly over the pit floor in the August/Little Ben pit, followed by 18 inches of soil. About 28 acres of pit floor and bench would be revegetated.

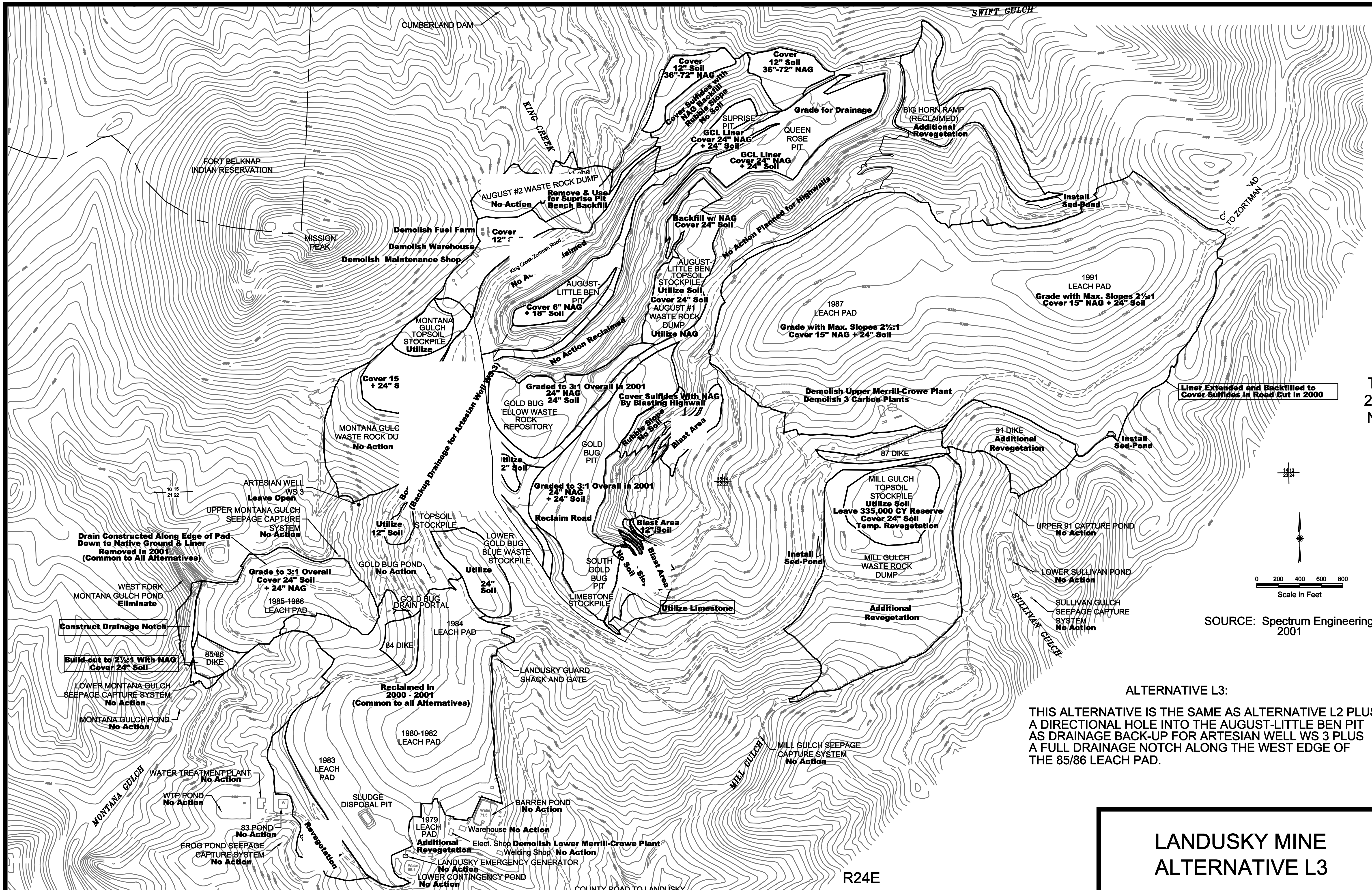

CUMBERLAND DAM
SWIFT GULCH
KING CREEK
Cover 12" Soil 36"-72" NAG
Cover 12" Soil 36"-72" NAG
Cover Sulfides with NAG Backfill Rubble Slope No Soil
SUPRISE PIT
GCL Liner Cover 24" NAG + 24" Soil
QUEEN ROSE PIT
GCL Liner Cover 24" NAG + 24" Soil
Grade for Drainage
BIG HORN RAMP (RECLAIMED) Additional Revegetation
FORT BELKNAP INDIAN RESERVATION
AUGUST #2 WASTE ROCK DUMP No Action
Remove & Use for Suprise Pit Bench Backfill
MISSION PEAK
Demolish Fuel Farm
Demolish Warehouse
Demolish Maintenance Shop
King Creek-Zortman Road
Backfill w/ NAG Cover 24" Soil
No Action Planned for Highwalls
Install Sed-Pond
TO ZORTMAN
AUGUST-LITTLE BEN PIT
Cover 6" NAG + 18" Soil
AUGUST-LITTLE BEN TOPSOIL STOCKPILE Utilize Soil
Cover 24" Soil
AUGUST #1 WASTE ROCK DUMP Utilize NAG
No Action Reclaimed
MONTANA GULCH TOPSOIL STOCKPILE Utilize
1987 LEACH PAD Grade with Max. Slopes 2½:1 Cover 15" NAG + 24" Soil
1991 LEACH PAD Grade with Max. Slopes 2½:1 Cover 15" NAG + 24" Soil
Cover 15 + 24" S
(Backup Drainage for Artesian Well WS 3)
Graded to 3:1 Overall in 2001 24" NAG 24" Soil
GOLD BUG YELLOW WASTE ROCK REPOSITORY
Cover Sulfides With NAG By Blasting Highwall
Demolish Upper Merrill-Crowe Plant Demolish 3 Carbon Plants
Liner Extended and Backfilled to Cover Sulfides in Road Cut in 2000
T 25 N
MONTANA GULCH WASTE ROCK DUMP No Action
Rubble Slope No Soil
Blast Area
GOLD BUG PIT
91 DIKE Additional Revegetation
Install Sed-Pond
87 DIKE
ARTESIAN WELL WS 3 Leave Open
Graded to 3:1 Overall in 2001 24" NAG + 24" Soil
Reclaim Road
MILL GULCH TOPSOIL STOCKPILE Utilize Soil Leave 335,000 CY Reserve Cover 24" Soil Temp. Revegetation
UPPER MONTANA GULCH SEEPAGE CAPTURE SYSTEM No Action
Utilize 12" Soil
TOPSOIL STOCKPILE
Blast Area 12" Soil
Blast Area
UPPER 91 CAPTURE POND No Action
Drain Constructed Along Edge of Pad Down to Native Ground & Liner Removed in 2001 (Common to All Alternatives)
LOWER GOLD BUG BLUE WASTE STOCKPILE
SOUTH GOLD BUG PIT
Install Sed-Pond
MILL GULCH WASTE ROCK DUMP
LOWER SULLIVAN POND No Action
GOLD BUG POND No Action
Utilize 24" Soil
0 200 400 600 800
Scale in Feet
WEST FORK MONTANA GULCH POND Eliminate
Grade to 3:1 Overall Cover 24" Soil + 24" NAG
LIMESTONE STOCKPILE
Utilize Limestone
SULLIVAN GULCH
SULLIVAN GULCH SEEPAGE CAPTURE SYSTEM No Action
1985-1986 LEACH PAD
GOLD BUG DRAIN PORTAL
Additional Revegetation
Construct Drainage Notch
1984 LEACH PAD
SOURCE: Spectrum Engineering 2001
85/86 DIKE
84 DIKE
Build-out to 2½:1 With NAG Cover 24" Soil
LANDUSKY GUARD SHACK AND GATE
LOWER MONTANA GULCH SEEPAGE CAPTURE SYSTEM No Action
Reclaimed in 2000 - 2001 (Common to all Alternatives)
ALTERNATIVE L3:
THIS ALTERNATIVE IS THE SAME AS ALTERNATIVE L2 PLUS A DIRECTIONAL HOLE INTO THE AUGUST-LITTLE BEN PIT AS DRAINAGE BACK-UP FOR ARTESIAN WELL WS 3 PLUS A FULL DRAINAGE NOTCH ALONG THE WEST EDGE OF THE 85/86 LEACH PAD.
MONTANA GULCH POND No Action
1980-1982 LEACH PAD
MILL GULCH SEEPAGE CAPTURE SYSTEM No Action
MILL GULCH
1983 LEACH PAD
MONTANA GULCH
WATER TREATMENT PLANT No Action
WTP POND No Action
SLUDGE DISPOSAL PIT
BARREN POND No Action
83 POND No Action
Revegetation
1979 LEACH PAD Additional Revegetation
Warehouse No Action
Elect. Shop Demolish Lower Merrill-Crowe Plant
Welding Shop No Action
FROG POND SEEPAGE CAPTURE SYSTEM No Action
LANDUSKY EMERGENCY GENERATOR No Action
LOWER CONTINGENCY POND No Action
COUNTY ROAD TO LANDUSKY
R24E
LANDUSKY MINE
ALTERNATIVE L3

FIGURE 2.4-11

Queen Rose Pit

The Queen Rose pit floor would be backfilled and graded to drain freely toward the partially backfilled Suprise pit. The regraded pit floor (approximately 15 acres) would be covered with a GCL liner, 6-inch thick layer of NAG, 18 inches of soil, and revegetated.

Gold Bug and South Gold Bug Pits

In the later stages of the mining operation the Gold Bug pit was partially backfilled and lower sections of the backfilled area were reclaimed. The remainder of the backfilled area would be graded with maximum 3H:1V slopes. All depressions and benches would be eliminated, producing a free draining surface.

Limited highwall reduction would be used to cover the exposed sulfide zone with non-acid generating rubble. This work would entail improving an existing exploration road up to the top of the ridge, stripping soil from 3.58 acres along the ridge top, and then blasting 93,000 bank cubic yards of NAG material in the stripped area. Bulldozers would push the blasted material over the edge of the highwall. The blasted NAG would be allowed to pile up along the face of the highwall, forming a wedge-shaped cover over the lower section of the pit wall. The rubble slope would be left at its angle of repose and would not be graded or covered. The highwall reduction source area at the top of the ridge would be regraded, covered with 12 inches of soil, and revegetated.

After the limestone stockpile in the South Gold Bug pit has been removed and utilized either as NAG cover or fill, the benches on the west side of the pits would be reduced to 3H:1V slopes to produce a free draining surface. The regraded area of the Gold Bug pit complex (approximately 29 acres), would be covered with 24 inches of NAG, 24 inches of soil, and revegetated.

Leach Pad Reclamation

All spent ore heaps would be recontoured to provide a topography that blends into the surrounding landscape. The leach pads would be reclaimed in place with some redistribution of the spent ore onto associated dikes and to areas adjacent the leach pads. All of the pads in the southwest corner of the mine area would be graded to reduce pad slopes to an overall 3H:1V grade. In most cases, there would be no need to incorporate benches into the regrading designs for these relatively low heaps. The L87 and L91 leach pads would be regraded with maximum 2.5H:1V slopes and 25-foot wide benches constructed on 100-foot vertical spacing. Slope reduction would be performed, in part, by bulldozers pushing ore heap material from the top of the facility down over the lift slopes. Where the desired grades could not be obtained by dozing alone, trucks and loaders would be used to offload and redistribute the material into fill areas. Depending on the acid generating potential of the material in the heap, leach pad surfaces would be covered with a combination of NAG material and soil. The total cover thickness would vary by pad from 24 to 39 inches. The reclamation cover would then be revegetated.

Additional reclamation work would be performed on the L84 and L85/86 dikes. The L84 dike would be built out to a nominal 3H:1V slope. The L85/86 dike would be built out to a nominal 2.5H:1V slope. Because NAG fill would be used in the buildout, the reclamation cover would be limited to 24 inches of soil and the dike faces would be revegetated.

L79 Leach Pad

The L79 leach pad is part of the complex of leach pads located near the lower Merrill-Crowe plant at the southwest corner of the mine. This pad has already been reclaimed with 8 to 12 inches of soil and revegetated in September 1991. The existing reclamation would be enhanced with additional fertilization, seeding, and planting.

L80-82, L83, and L84 Leach Pads

Regrading of the L80-82, L83, and L84 leach pads was undertaken as part of the 2000 interim reclamation project. Approximately 1.1 million cubic yards of grading and excavation were conducted to recontour these heaps to final overall grades of less than 3H:1V. Because the pads were reduced to a height of just over 100 feet, benching was not incorporated into the grading plan. The regrading plan required some offloading of the spent ore onto unlined and partially lined areas adjacent to the pads and included filling several large depressions between the L80-82 and L83 leach pads and extending the backfill over the upper contingency pond and the process water pond.

Before applying the interim reclamation cover, the regraded surface was sampled for acid generating potential to a depth of 24 inches on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of King Creek tailings were placed as cover material, followed by 18 inches of soil. The 74-acre surface was seeded in 2001. This interim reclamation cover would be considered final.

Reclamation on the L83 dike would be enhanced with additional fertilization, seeding, and planting to improve the existing vegetation. The L84 dike at the north end of the pad complex would be built out to a 3H:1V slope with about 61,000 cubic yards of material borrowed from the L85/86 leach pad. In conjunction with this effort, the over-steepened slope to the south of the dike would be rebuilt using material offloaded from the L80/82 and L85/86 leach pads. All of the material used in the dike and slope buildout would be NAG. The regraded dike would be covered with 24 inches of soil and revegetated.

L85/86 Leach Pad

The north and west sides of the pad would be excavated to re-establish drainage around the pad. On the north side of the pad, the base of the heap would be pulled back away from the hillside about 60 feet, permitting construction of a channel between the upper Montana Gulch seepage capture system and the West Fork Montana Gulch pond, which is contained in a blocked tributary behind the L85/86 pad. Nearly all of the excavated material would be used to build out the L84 dike and recontour the disturbed hillside south and west of the dike with 3H:1V slopes.

A second drainage channel would be constructed along the west margin of the L85/86 leach pad to completely unblock surface water drainage and eliminate the West Fork pond. This channel is the same design as used in Alternative L1. An estimated 113,800 bank cubic yards of excavation along the abutting hillside would occur to re-establish a free draining channel. The channel would connect into an existing lined channel that by-passes the capture system. The material generated by this excavation would be used as NAG fill and NAG cover on the L85/86 dike and in the Gold Bug pit.

Alternative L3 incorporates all of the work accomplished by interim reclamation. In addition, contouring on the south and east sides of the pad would continue. Relocation of the access roads to the capture system and final grading of the leach pad surface to overall 3H:1V slopes would also occur. The relocated road would function as a bench breaking some of the slopes. No other benches would be constructed.

The amount of slope reduction that can be achieved by dozing is limited to about 77,000 cubic yards. In addition to the material moved during interim reclamation, another 274,000 cubic yards of material would be moved to the northeast end of the pad by trucks, where it would be placed in the gap between the upper edge of the pad and the hillside. A large portion of the material would be placed off the liner; however, seepage into the fill would still drain toward the lined area.

The slope on the front of the L85/86 dike would be built out to a 2.5H:1V slope using about 27,000 cubic yards of material from the drainage excavation. After reconstructing the face of this dike, it would be covered with 24 inches of soil and revegetated. Approximately 3 acres of surface would be revegetated.

The pad regrade area would be tested for acid generating potential. Areas requiring neutralization would be amended with lime to insure that 24 inches of NAG would cover the entire area. Then the surface would be covered with 24 inches of soil and revegetated.

<u>L87/91 Leach Pad</u>

The entire L87/91 leach pad would be regraded with maximum 2.5H:1V slopes with 25-foot wide benches spaced every 100 vertical feet. A 45-foot wide access road would be substituted for one of the benches on the south side of the L91 dike. The leach pad liner would be extended on the southeast side of the leach pad to maximize the quantity of spent ore that could be moved downhill to achieve an overall slope configuration between 2.6H:1V and 3H:1V and still keep the spent ore on a lined surface. The extension of the leach pad liner on the southeast side of the L91 leach pad has already been incorporated into the 2000-2001 interim grading plan.

The grading plan would include the following excavation and haulage: 1,884,000 cubic yards of bulldozer grading; and 102,000 cubic yards of truck/loader redistribution. The regraded surface on both pads would be covered with 15 inches of NAG and 24 inches of soil. The entire 201 acres would be revegetated. All of the facilities on the leach pads, with the exception of the pumping facilities, would be removed before the grading occurred. The large pond on the top of the L87 leach pad would be backfilled during the grading operation.

The L87 dike is considered to be reclaimed as it is covered by the Mill Gulch waste rock dump. No additional grading would occur on the 350-foot high L91 dike. Buttressing of the dike is not necessary as it is stable in its current configuration (see Section 3.2.2, Geotechnical Conditions). However, the existing vegetation would be improved with additional fertilization, seeding, and planting.

Waste Rock Dump Reclamation

Mill Gulch Waste Rock Dump

The only portion of the waste rock dump presently unreclaimed is occupied by the Mill Gulch soil stockpile on the top of the dump. A reserve of 335,000 cubic yards of soil would be retained in this stockpile. Reclamation would consist of regrading and seeding the top of the stockpile area after it is removed. The existing reclamation on the face of the dump would be enhanced with additional fertilization, seeding, and planting if necessary.

Montana Gulch Waste Rock Dump

The soil stockpile and the truck ready-line would be removed from the Montana Gulch waste rock dump. The top of the dump would then be covered with 15 inches of NAG material and 24 inches of soil. In those areas where removal of the soil stockpile exposed native ground, 12 inches of soil would be placed. About 6.6 acres on the waste dump and 6.8 acres of soil stockpile footprint would be revegetated. In other areas of the dump such as the front and side slopes, the existing reclamation would be considered the final reclamation.

August #1 Waste Rock Dump

The August #1 waste rock dump is spread across several of the topmost benches on the south side of the August/Little Ben pit. Because the August/Little Ben soil stockpile was dumped over the top of the waste rock dump, the two piles are mixed together to some degree.

Material from the two piles would be segregated and used in the reclamation of various areas around the Landusky Mine. Enough of the waste rock dump would be left in place to grade the dump and stockpile areas plus an additional 5 acres of adjacent pit benches to 3H:1V slopes. The bench cover would use about 124,000 cubic yards of stockpile material and 6,000 cubic yards of bench reduction. The pit benches that would be reclaimed are on the north side of the stockpile and below it. All 14.8 acres of the stockpile footprint and the regraded area would be covered with 24 inches of soil and revegetated.

August #2 Waste Rock Dump

The west lobe of the August #2 waste rock dump has been graded to blend into the natural terrain and covered with 8 to 12 inches of soil. Trees were planted on this lobe in April 1990 and again in April 1991. This reclamation would be considered final.

The east lobe, containing about 599,000 cubic yards of material, sits on the north wall of the August/Little Ben pit. This lobe was covered with 8 to 12 inches of soil and revegetated in May 1992. The existing soil and vegetation would be stripped and the entire east lobe would be excavated. The material would be used as a NAG source for covering the slopes and pit benches within the Suprise pit and backfilling the floor of the Queen Rose pit. The 8.56-acre footprint of the east lobe would be covered with 12 inches of soil and revegetated.

Gold Bug Yellow Waste Rock Repository

This dump would be regraded to 3H:1V slopes or flatter. The 13.1-acre regraded area would be covered with 24 inches of NAG material, 24 inches of soil, and revegetated.

Lower Gold Bug Blue Waste Rock Stockpile

The material in the lower Gold Bug blue waste rock stockpile has been characterized as non-acid generating and would be used in construction of the reclamation covers. The remaining footprint would be covered with 24 inches of soil and revegetated.

Upper Gold Bug Blue Waste Rock Stockpile

The material in the upper Gold Bug blue waste rock stockpile has been characterized as non-acid generating and would be used in construction of the reclamation covers. The remaining footprint would be covered with 12 inches of soil and revegetated.

Support Facilities Reclamation

All of the mining-related facilities not associated with water treatment would be removed, their footprints covered with 12 inches of soil, and revegetated. This includes the fuel farm, upper warehouse, maintenance shop, lower Merrill-Crowe plant, three carbon plants, and the Landusky Mine guard shack and gate. The upper Merrill-Crowe plant would be left for use in the biological treatment process.

The water treatment plant, drainage capture systems, ponds, and associated structures would be left intact and continue functioning where presently located until no longer needed. Once removed, their footprints would be regraded, covered with soil, and revegetated.

Alternative L4, Removal and Backfill of L85/86 Leach Pad (Preferred Alternative)

Alternative L4 would cost approximately twice the available reclamation bond amount. It would include removing the L85/86 leach pad and dike from the Montana Gulch drainage and hauling them to the August/Little Ben pit as pit backfill. Additional highwall reduction and backfill would be used to cover various sections of the pit wall throughout the pit complex. The reclamation for each mine feature is shown in Figure 2.4-12. Those mine features that would be considered already reclaimed and not receiving additional reclamation work under this alternative are labeled "No Action" or "Reclaimed in 2000-2001."

Mine Pit Reclamation

August/Little Ben-Suprise Pit Complex

Non-acid generating backfill would be placed in the Suprise pit to establish a 3% grade. A bentonite layer would be placed over the graded fill as a subbase and then a GCL liner would be placed over the compacted bentonite to minimize water infiltration through the pit floor. All exposed sulfides in the Suprise pit would be covered with NAG fill from the east lobe of the August #2 waste rock dump and the L85/86 leach pad. This material would be end-dumped over the highwall, creating a rubble slope at the angle of repose (approximately 1.3 to 1.4H:1V). The pit benches would also be covered with fill to a depth of 36 to 72 inches, and several feet of fill would be placed over the liner on the pit floor.

The 2.6 million cubic yards of material removed from the L85/86 leach pad would be placed in the August/Little Ben pit. Part of this material would be dumped over the highwall between the August #1 waste rock dump and the Gold Bug yellow waste rock repository. This material would be left as a steep rubble slope extending from the pit floor up to the top of the highwall. The remainder of the material would be placed in the bottom of the pit, raising the floor an average of 85 feet. The fill would be graded to drain to the south end of the pit where the elevation of the pit floor would be approximately 4715 feet amsl.

Pit drainage would be via infiltration through the fill into the groundwater system that is controlled by the artesian well in Montana Gulch. Pit drainage would be supplemented (if needed) by the addition of a directional drill hole from the August/Little Ben pit into Montana Gulch as described in Alternative L3.

Reclamation covers consisting of 24 inches of NAG and 24 inches of soil would be placed over the fill on the pit floors and over the benches on the north and west sides of the Suprise pit. Because most of the fill material would be non-acid generating, the NAG layer would be produced by adding agricultural lime into the top 24 inches of the graded backfill. Approximately 33 acres would be revegetated.

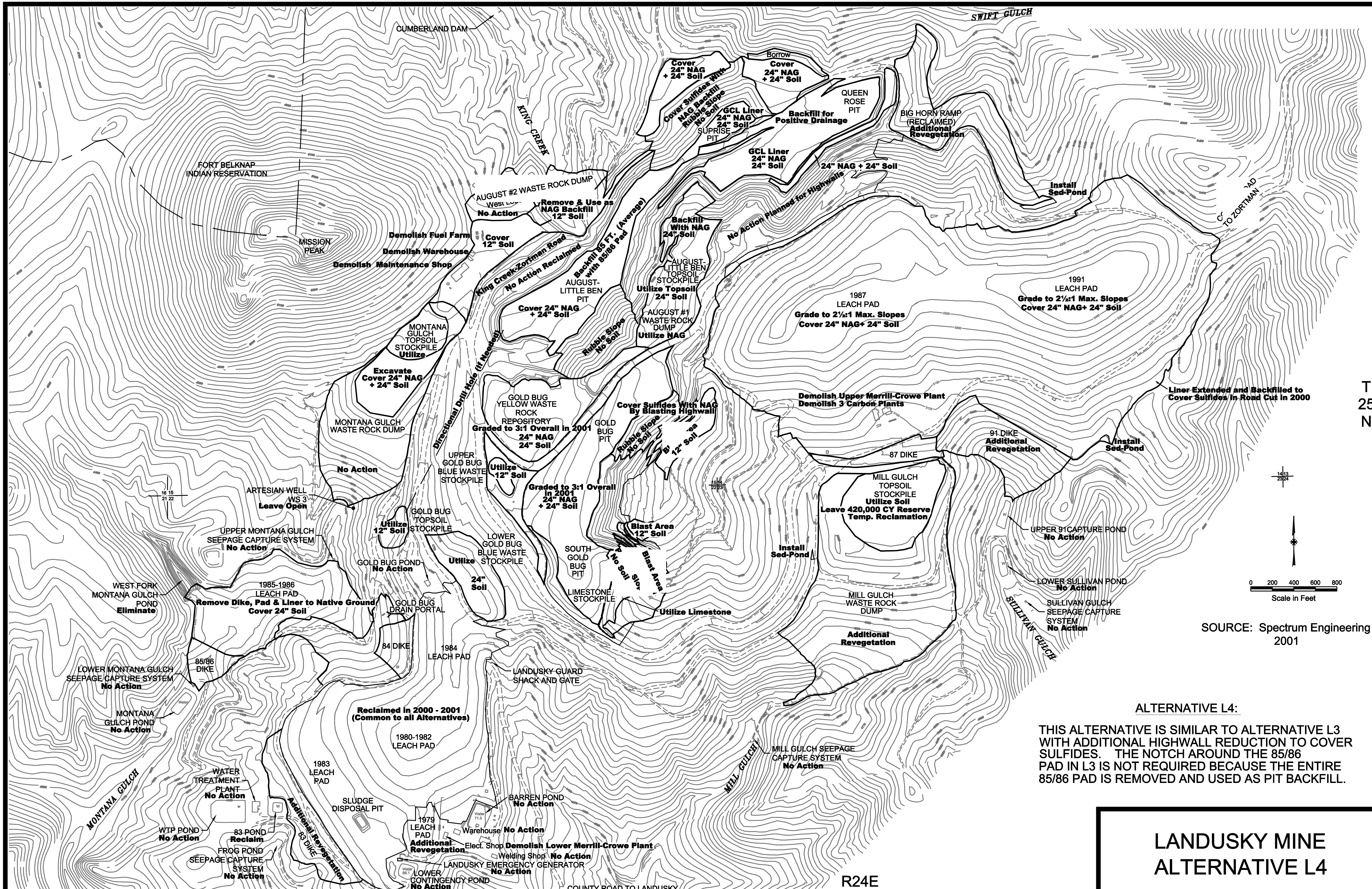

CUMBERLAND DAM
SWIFT GULCH
KING CREEK
FORT BELKNAP
INDIAN RESERVATION
MISSION PEAK
Borrow
Cover
24" NAG
+ 24" Soil
Cover
24" NAG
+ 24" Soil
Cover Sulfides With NAG Backfill
Rubble Slope
No Soil
GCL Liner
24" NAG
24" Soil
SUPRISE PIT
QUEEN ROSE PIT
Backfill for Positive Drainage
BIG HORN RAMP (RECLAIMED)
Additional Revegetation
GCL Liner
24" NAG
24" Soil
24" NAG + 24" Soil
AUGUST #2 WASTE ROCK DUMP
Remove & Use as NAG Backfill
12" Soil
No Action
Demolish Fuel Farm
Cover
12" Soil
Demolish Warehouse
Demolish Maintenance Shop
King Creek-Zortman Road
No Action Reclaimed
Backfill 85 FT. (Average) with 85/86 Pad
AUGUST-LITTLE BEN PIT
Backfill With NAG
24" Soil
No Action Planned for Highwalls
Install Sed-Pond
TO ZORTMAN
AUGUST-LITTLE BEN TOPSOIL STOCKPILE
Utilize Topsoil
24" Soil
Cover 24" NAG
+ 24" Soil
Rubble Slope
No Soil
AUGUST #1 WASTE ROCK DUMP
Utilize NAG
1987 LEACH PAD
Grade to 2½:1 Max. Slopes
Cover 24" NAG+ 24" Soil
1991 LEACH PAD
Grade to 2½:1 Max. Slopes
Cover 24" NAG+ 24" Soil
MONTANA GULCH TOPSOIL STOCKPILE
Utilize
Excavate
Cover 24" NAG
+ 24" Soil
Directional Drill Hole (If Needed)
GOLD BUG YELLOW WASTE ROCK REPOSITORY
Graded to 3:1 Overall in 2001
24" NAG
24" Soil
Cover Sulfides With NAG By Blasting Highwall
GOLD BUG PIT
Rubble Slope
No Soil
12" Soil
Demolish Upper Merrill-Crowe Plant
Demolish 3 Carbon Plants
Liner Extended and Backfilled to Cover Sulfides in Road Cut in 2000
T 25 N
MONTANA GULCH WASTE ROCK DUMP
No Action
UPPER GOLD BUG BLUE WASTE STOCKPILE
Utilize
12" Soil
Graded to 3:1 Overall in 2001
24" NAG
+ 24" Soil
91 DIKE
Additional Revegetation
87 DIKE
Install Sed-Pond
MILL GULCH TOPSOIL STOCKPILE
Utilize Soil
Leave 420,000 CY Reserve
Temp. Reclamation
ARTESIAN WELL
WS 3
Leave Open
GOLD BUG TOPSOIL STOCKPILE
Utilize
12" Soil
Blast Area
12" Soil
Blast Area
No Soil
UPPER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
LOWER GOLD BUG BLUE WASTE STOCKPILE
Utilize
24" Soil
SOUTH GOLD BUG PIT
Install Sed-Pond
UPPER 91CAPTURE POND
No Action
GOLD BUG POND
No Action
WEST FORK MONTANA GULCH POND
Eliminate
1985-1986 LEACH PAD
Remove Dike, Pad & Liner to Native Ground
Cover 24" Soil
GOLD BUG DRAIN PORTAL
LIMESTONE STOCKPILE
Utilize Limestone
LOWER SULLIVAN POND
No Action
0 200 400 600 800
Scale in Feet
MILL GULCH WASTE ROCK DUMP
SULLIVAN GULCH SEEPAGE CAPTURE SYSTEM
No Action
SULLIVAN GULCH
SOURCE: Spectrum Engineering 2001
85/86 DIKE
84 DIKE
1984 LEACH PAD
Additional Revegetation
LOWER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
LANDUSKY GUARD SHACK AND GATE
MONTANA GULCH POND
No Action
Reclaimed in 2000 - 2001
(Common to all Alternatives)
1980-1982 LEACH PAD
ALTERNATIVE L4:
THIS ALTERNATIVE IS SIMILAR TO ALTERNATIVE L3
WITH ADDITIONAL HIGHWALL REDUCTION TO COVER
SULFIDES. THE NOTCH AROUND THE 85/86
PAD IN L3 IS NOT REQUIRED BECAUSE THE ENTIRE
85/86 PAD IS REMOVED AND USED AS PIT BACKFILL.
MILL GULCH SEEPAGE CAPTURE SYSTEM
No Action
MILL GULCH
MONTANA GULCH
WATER TREATMENT PLANT
No Action
1983 LEACH PAD
SLUDGE DISPOSAL PIT
BARREN POND
No Action
WTP POND
No Action
83 POND
Reclaim
Additional Revegetation
83 DIKE
1979 LEACH PAD
Additional Revegetation
Warehouse No Action
Elect. Shop Demolish Lower Merrill-Crowe Plant
Welding Shop No Action
FROG POND SEEPAGE CAPTURE SYSTEM
No Action
LANDUSKY EMERGENCY GENERATOR
No Action
LOWER CONTINGENCY POND
No Action
COUNTY ROAD TO LANDUSKY
R24E
LANDUSKY MINE
ALTERNATIVE L4

FIGURE 2.4-12

Queen Rose Pit

The floor of the Queen Rose pit would be backfilled and graded to produce a surface that directs runoff toward the Suprise pit. The entire pit floor would be lined with a GCL liner. Then the pit floor and about 3.5 acres of accessible pit bench would be covered with 24 inches of NAG and 24 inches of soil. In the pit backfill areas, the NAG layer would be produced by treating the top 24 inches of fill with agricultural lime. Approximately 20 acres would be revegetated.

Gold Bug and South Gold Bug Pits

In the later stages of the mining operation, the Gold Bug pit was partially backfilled and lower sections of the backfilled area were reclaimed. Under this alternative, the remainder of the backfilled area would be graded to 3H:1V slopes or less. All depressions and benches would be eliminated to produce a free draining surface.

Limited highwall reduction would be conducted at the north end of the Gold Bug pit to cover the exposed sulfide zone with non-acid generating rubble. This work would entail improving an existing exploration road up to the top of the ridge, stripping soil from 3.58 acres along the ridge top, and then blasting 93,000 bank cubic yards of NAG material in the stripped area. Bulldozers would push the blasted material over the edge of the highwall. The blasted NAG would be allowed to pile up along the face of the highwall, forming a wedge-shaped cover over the lower section of the pit wall. The rubble slope would be left at its angle of repose. The highwall reduction source area at the top of the ridge would be regraded, covered with 12 inches of soil, and revegetated.

The limestone stockpile in the South Gold Bug pit would be removed and used as NAG cover. The benches on the west side of the pits would be reduced to 3H:1V slopes, producing a free draining surface. Then the pit walls on the north and west sides would be reduced by blasting about 4.8 acres along the top of the highwall. The blasted material would be pushed into the pits, creating a steep rubble slope covering most of the pit walls. The reduction area above the rubble slope would be regraded with maximum 3H:1V slopes before being covered with 12 inches of soil, while the rubble slope would be left in a rough, uncovered condition. A reclamation cover consisting of 24 inches of soil over 24 inches of NAG would be placed over the remaining 27.5 acres in the Gold Bug pit complex.

Leach Pad Reclamation

The L85/86 leach pad and dike would be removed from Montana Gulch. The L87/91 leach pad would be reshaped to reduce the slopes to a maximum grade of 2.5H:1V incorporating 25-foot wide benches every 100 vertical feet. The reclamation on the L80/82-L83-L84 leach pad complex would be considered final. The L84 dike would be built out to a slope of 3H:1V. Reclamation of the L79 leach pad, the L91 dike, and the L83 dike would be considered complete except for additional revegetation.

The leach pads and dikes would be covered with at least 24 inches of NAG, followed by 24 inches of soil. The NAG layer could be imported from the mine stockpiles or could be created by treating the in-place materials with lime.

L79 Leach Pad

The L79 leach pad has already been regraded, reclaimed with 8 to 12 inches of soil, and revegetated in September 1991. The existing reclamation would be enhanced with additional fertilization, seeding, and planting, if needed.

L80-82, L83, and L84 Leach Pads

Regrading of these leach pads was undertaken as part of the 2000 interim reclamation project. Approximately 1.1 million cubic yards of grading and excavation were conducted to recontour these heaps to a final grade of less than 3H:1V. Because the pads were reduced to a height of just over 100 feet, benching was not incorporated into the regrading. The regrading plan required some offloading of the spent ore onto unlined and partially lined areas adjacent to the pads, and included filling several large depressions between the L80-82 and L83 Pads and extending the backfill over the upper contingency pond and the process water pond.

Before applying the interim reclamation cover, the regraded surface was sampled for acid generating potential to a depth of 24 inches on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of King Creek tailings were placed as cover material, followed by 18 inches of soil. The 74 acres of surface were seeded in 2001. This interim reclamation would be considered final. However, the existing reclamation on the L83 dike would be improved with additional fertilization, seeding, and planting, if needed.

The L84 dike at the north end of the pad complex would be built out to a 3H:1V slope with about 61,000 cubic yards of material borrowed from the L85/86 pad. In conjunction with this effort, the over-steepened slope to the south of the dike would be rebuilt using material offloaded from the L80/82 and L85/86 leach pads. All of the material used in the dike and slope buildout is expected to be NAG. However, the regraded surfaces would be tested for acid generating potential before applying 24 inches of soil and seeding the 11.2 acres of reclamation.

L85/86 Leach Pad

The entire L85/86 leach pad and dike would be removed from the bottom of Montana Gulch. Leach pad removal work would include removing the exposed leach pad liner and reconstructing the drainage bottom, which would remove the spent ore blocking free drainage through this section of the gulch. In most areas, removal would extend down to the pre-mining surface. Most of the material (2,577,000 cubic yards) would be hauled to the August/Little Ben-Suprise pit complex, or to the South Gold Bug Pit area, and used as pit backfill. The remainder of the heap (413,000 cubic yards) would be used for interim reclamation to build out the L84 dike and the adjacent over-steepened slope to the south.

Due to the steep pre-mining surface below the L84 dike buildout areas, portions of the heap would be left in place to stabilize the base of this dike. Access roads through this area would also be relocated. The entire 27.6 acres associated with the pad and dike removal would be covered with 24 inches of soil and revegetated.

<u>L87/91 Leach Pad</u>

The entire L87/91 leach pad would be regraded with maximum 2.5H:1V slopes with 25-foot wide constructed benches spaced every 100 vertical feet. A 45-foot wide access road would be substituted for one of the benches on the south side of the L91 dike. The leach pad liner would be extended on the southeast side of the leach pad to maximize the quantity of spent ore that could be moved downhill to achieve an overall slope configuration between 2.6H:1V and 3H:1V. The extension of the liner on the southeast side of the L91 pad was conducted as part of the 2000-2001 interim reclamation.

The grading plan would include 1,884,000 cubic yards of bulldozer grading and 102,000 cubic yards of truck/loader redistribution. The regraded surface on both pads would be covered with 24 inches of NAG and 24 inches of soil. The entire 203-acre area would be revegetated. All of the facilities on the pads, with the exception of the pumping facilities, would be removed. The large pond on the top of the L87 pad would be backfilled during the grading operation.

The L87 dike is considered to be reclaimed as it is covered by the Mill Gulch waste rock dump. No additional grading would occur on the 350-foot high L91 dike. Buttressing of the L91 dike is not necessary as it is stable in its current configuration (see Section 3.2.2, Geotechnical Conditions). However, the existing vegetation would be improved with additional fertilization, seeding, and planting.

Waste Rock Dump Reclamation

<u>Mill Gulch Waste Rock Dump</u>

The only portion of the Mill Gulch waste rock dump presently unreclaimed is occupied by the Mill Gulch soil stockpile on the top of the dump. Approximately 202,000 cubic yards of Landusky Mine soil would be transferred to the Zortman Mine site and a reserve of 218,000 cubic yards would be retained in this soil stockpile. Reclamation would consist of regrading and seeding the stockpile area after it is removed. The existing reclamation on the face of the dump would be enhanced with additional fertilization, seeding, and planting, if needed.

Montana Gulch Waste Rock Dump

The soil stockpile and truck ready-line would be removed from the top of the dump. The dump would then be graded. The regraded surface would be sampled for acid generating potential to a depth of 2 feet on a grid spacing of 100 feet. Grids with a net acid potential would be neutralized with lime. This procedure would provide at least 24 inches of NAG at the top of the regraded surface. After liming, 24 inches of soil would be spread over the top of the dump. In those areas where removal of the soil stockpile exposed native ground, 12 inches of soil would be placed. About 6.6 acres on the waste dump and 6.8 acres of the soil stockpile footprint would be revegetated. In other areas of the dump such as the front and side slopes, the existing reclamation would be considered final.

August #1 Waste Rock Dump

The August #1 waste rock dump is spread across several of the topmost benches on the south side of the August/Little Ben pit. Because the August/Little Ben soil stockpile was dumped over the top of the waste dump, the two piles are mixed together to some degree.

Material from the two piles would be segregated and used in the reclamation of various areas around the Landusky Mine. Enough of the waste rock dump would be left in place to grade the dump and stockpile areas plus an additional 5 acres of adjacent pit benches to 3H:1V slopes. The bench cover would use about 124,000 cubic yards of stockpile material and 6,000 cubic yards of bench reduction. The pit benches that would be reclaimed are north of, and below, the soil stockpile. Some 15 acres within the stockpile footprint and in the regraded bench area would be covered with 24 inches of soil and revegetated.

August #2 Waste Rock Dump

The west lobe of the August #2 waste rock dump has been graded to blend into the natural terrain and covered with 8 to 12 inches of soil. Trees were planted in April 1990 and again in April 1991. The existing reclamation on the west lobe of the waste rock dump would be considered final.

The east lobe, containing about 599,000 cubic yards of material, sits on the north wall of the August/Little Ben pit. This lobe was covered with 8 to 12 inches of soil and revegetated in May 1992. The material in this dump is non-acid generating. The existing soil and vegetation would be stripped off and the east lobe would be completely removed and used for NAG fill and cover. After removal, the exposed slopes would be covered with 12 inches of soil and revegetated. The King Creek-to-Zortman access road would be relocated through the dump footprint.

Gold Bug Yellow Waste Rock Repository

The Gold Bug yellow waste rock repository would be regraded to 3H:1V slopes or less. The 13-acre regraded surface would be covered with 24 inches of NAG, 24 inches of soil, and revegetated.

Lower Gold Bug Blue Waste Rock Stockpile

The material in the lower Gold Bug blue waste rock stockpile is non-acid generating. The stockpile would be removed and used in construction of the reclamation covers. The remaining footprint would be covered with 24 inches of soil and revegetated.

Upper Gold Bug Blue Waste Rock Stockpile

The material in the upper Gold Bug blue waste rock stockpile is non-acid generating. The stockpile would be removed and used in construction of the reclamation covers. The remaining footprint would be covered with 12 inches of soil and revegetated.

Support Facilities Reclamation

All of the mining-related facilities not associated with water treatment would be removed, their footprints covered with 12 inches of soil, and revegetated. These facilities include the fuel farm, upper warehouse, maintenance shop, lower Merrill-Crowe plant, three carbon plants, and the Landusky guard shack and gate. The upper Merrill-Crowe plant would be left for use in the biological treatment process.

The water treatment plant, drainage capture systems, ponds, and associated structures would be left intact and continue functioning where presently located until no longer needed. Once removed, their footprints would be regraded, covered with soil, and revegetated.

Alternative L5, Backfill to Cover Sulfide Highwalls

Alternative L5 would cost approximately four times the available reclamation bond amount. It would include substantial backfilling of the mine pit complex. All the pit highwalls in the sulfide zone would be covered with backfill and graded to a 2H:1V slope or less. The L85/86 leach pad and dike, and much of the spent ore from the L87 leach pad would be removed and used as backfill. The reclamation action for each mine feature is shown in Figure 2.4-13. Those mine features that would be considered reclaimed and not receiving additional reclamation work under this alternative are labeled “No Action” or “Reclaimed in 2000-2001.”

Mine Pit Reclamation

August/Little Ben-Suprise Pit Complex

Under this alternative, the pit complex would be extensively backfilled to establish a free draining surface and to cover nearly all of the exposed sulfide zones in the pit walls. Prior to backfilling, grading fill would be placed over the pit floor to produce a 3% grade sloping to the south end of the pit. A geosynthetic liner would be installed over this subgrade surface to limit water infiltration through the pit floor.

A drainage notch to Montana Gulch would be excavated through the pit wall on the southwest end of the August/Little Ben pit. The pit complex would be backfilled with 10,342,000 cubic yards of material. Because the bottom of the notch would be positioned at an elevation of 4822 feet amsl at the southwest end of the August pit, only 95,000 bank cubic yards of excavation through the bedrock wall of the pit would be required to break into Montana Gulch at a point where a connection could be made into the previously constructed surface water control system. Backfill within the pit complex would be sloped at approximately 1.3% all the way to the north end of the Suprise pit. A 2.4% gradient would be maintained along the roughly 500 feet of channel required to make the connection into the existing drainage facility.

Much of the backfill surface would be shaped by dumping material off the highwalls surrounding the pit and then dozing the material down on approximately 3H:1V slopes. Near the bottom of the slope the grade would gradually flatten out until a narrow, relatively flat bottom was created. Hence, the backfilled surface would have the appearance of a V-shaped trough extending from the end of the Suprise pit to the notch. Due to variations in the pit width and in the heights of the pit walls, the contours and grades would vary along both sides of the pit. In the wider areas of the pit, even the upper slopes would be more gentle than 3H:1V. The backfill would cover nearly all of the pit benches, including the upper benches at the north end of the Suprise pit.

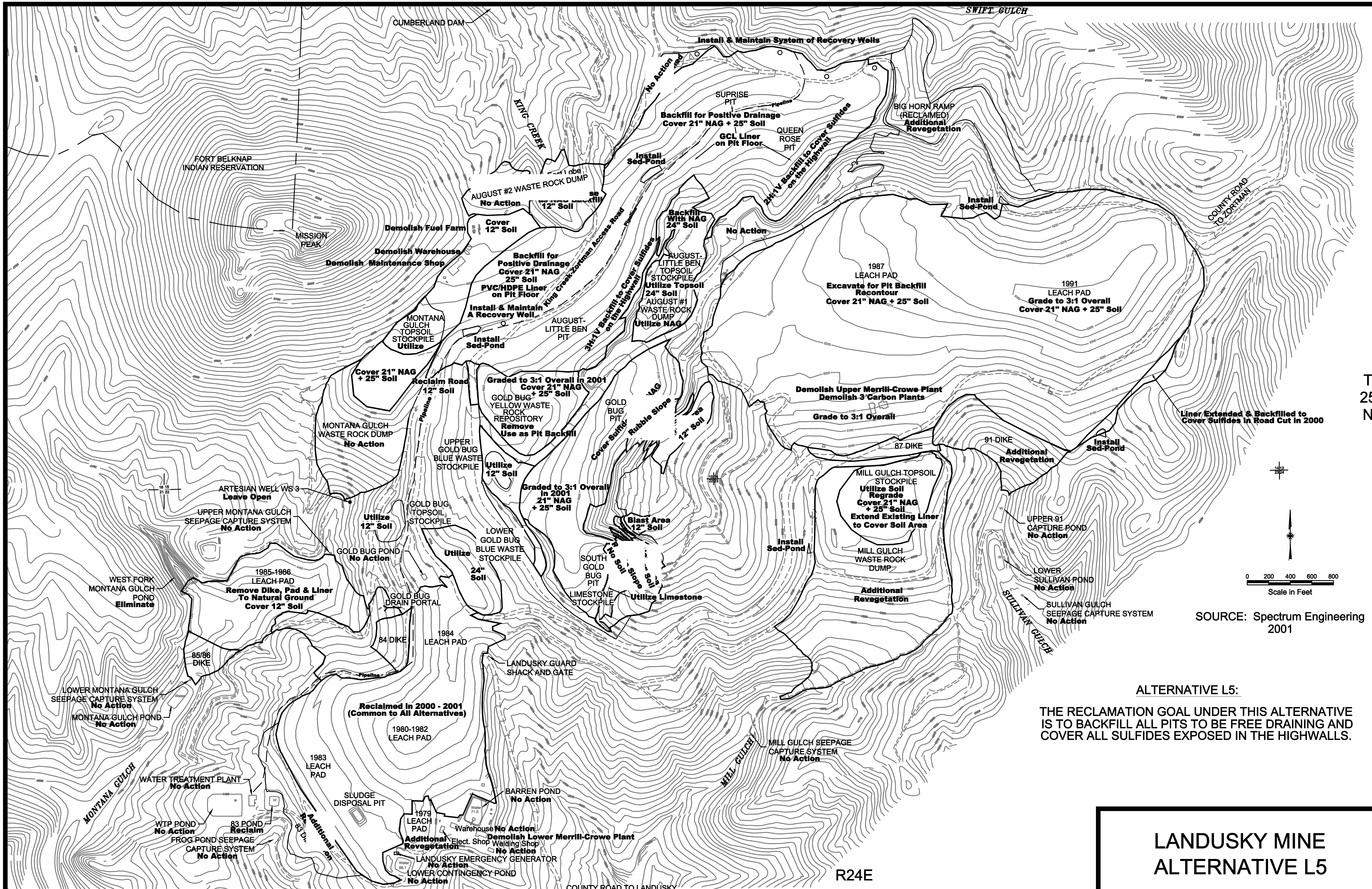

CUMBERLAND DAM
SWIFT GULCH
Install & Maintain System of Recovery Wells
No Action
KING CREEK
SUPRISE PIT
Pipeline
Backfill for Positive Drainage
Cover 21" NAG + 25" Soil
BIG HORN RAMP (RECLAIMED)
Additional Revegetation
GCL Liner on Pit Floor
QUEEN ROSE PIT
Install Sed-Pond
2H:1V Backfill to Cover Sulfides on the Highwall
FORT BELKNAP INDIAN RESERVATION
AUGUST #2 WASTE ROCK DUMP
No Action
12" Soil
Install Sed-Pond
COUNTY ROAD TO ZORTMAN
MISSION PEAK
Demolish Fuel Farm
Cover 12" Soil
Backfill With NAG 24" Soil
No Action
Demolish Warehouse
Demolish Maintenance Shop
Backfill for Positive Drainage
Cover 21" NAG
25" Soil
PVC/HDPE Liner on Pit Floor
King Creek-Zortman Access Road
AUGUST-LITTLE BEN TOPSOIL STOCKPILE
Utilize Topsoil 24" Soil
AUGUST #1 WASTE ROCK DUMP
Utilize NAG
1987 LEACH PAD
Excavate for Pit Backfill
Recontour
Cover 21" NAG + 25" Soil
1991 LEACH PAD
Grade to 3:1 Overall
Cover 21" NAG + 25" Soil
Install & Maintain A Recovery Well
MONTANA GULCH TOPSOIL STOCKPILE
Utilize
AUGUST-LITTLE BEN PIT
3H:1V Backfill to Cover Sulfides on the Highwall
Install Sed-Pond
Cover 21" NAG + 25" Soil
Reclaim Road 12" Soil
Graded to 3:1 Overall in 2001
Cover 21" NAG + 25" Soil
GOLD BUG YELLOW WASTE ROCK REPOSITORY
Remove
Use as Pit Backfill
GOLD BUG PIT
Cover Sulfides
Rubble Slope
12" Soil
Demolish Upper Merrill-Crowe Plant
Demolish 3 Carbon Plants
Grade to 3:1 Overall
T 25 N
Liner Extended & Backfilled to Cover Sulfides in Road Cut in 2000
MONTANA GULCH WASTE ROCK DUMP
No Action
Pipeline
UPPER GOLD BUG BLUE WASTE STOCKPILE
Utilize 12" Soil
87 DIKE
91 DIKE
Additional Revegetation
Install Sed-Pond
MILL GULCH TOPSOIL STOCKPILE
Utilize Soil
Regrade
Cover 21" NAG + 25" Soil
Extend Existing Liner to Cover Soil Area
ARTESIAN WELL WS 3
Leave Open
Graded to 3:1 Overall in 2001
21" NAG + 25" Soil
UPPER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
Utilize 12" Soil
GOLD BUG TOPSOIL STOCKPILE
Blast Area 12" Soil
UPPER 91 CAPTURE POND
No Action
LOWER GOLD BUG BLUE WASTE STOCKPILE
Install Sed-Pond
GOLD BUG POND
No Action
Utilize 24" Soil
SOUTH GOLD BUG PIT
No Soil
MILL GULCH WASTE ROCK DUMP
LOWER SULLIVAN POND
No Action
0 200 400 600 800
Scale in Feet
WEST FORK MONTANA GULCH POND
Eliminate
1985-1986 LEACH PAD
Remove Dike, Pad & Liner To Natural Ground
Cover 12" Soil
GOLD BUG DRAIN PORTAL
LIMESTONE STOCKPILE
Utilize Limestone
Additional Revegetation
SULLIVAN GULCH
SULLIVAN GULCH SEEPAGE CAPTURE SYSTEM
No Action
SOURCE: Spectrum Engineering 2001
84 DIKE
1984 LEACH PAD
85/86 DIKE
LANDUSKY GUARD SHACK AND GATE
Pipeline
LOWER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
MONTANA GULCH POND
No Action
Reclaimed in 2000 - 2001 (Common to All Alternatives)
1980-1982 LEACH PAD
ALTERNATIVE L5:
THE RECLAMATION GOAL UNDER THIS ALTERNATIVE IS TO BACKFILL ALL PITS TO BE FREE DRAINING AND COVER ALL SULFIDES EXPOSED IN THE HIGHWALLS.
MILL GULCH SEEPAGE CAPTURE SYSTEM
No Action
MILL GULCH
1983 LEACH PAD
MONTANA GULCH
WATER TREATMENT PLANT
No Action
SLUDGE DISPOSAL PIT
BARREN POND
No Action
WTP POND
No Action
83 POND
Reclaim
1979 LEACH PAD
Additional Revegetation
Warehouse No Action
Elect. Shop
Demolish Lower Merrill-Crowe Plant
Welding Shop
No Action
FROG POND SEEPAGE CAPTURE SYSTEM
No Action
LANDUSKY EMERGENCY GENERATOR
No Action
LOWER CONTINGENCY POND
No Action
R24E
COUNTY ROAD TO LANDUSKY
LANDUSKY MINE
ALTERNATIVE L5

FIGURE 2.4-13

Backfill material for the pit complex would come from the following sources:

L85/86 leach pad and dike	2,059,000 cubic yards
Gold Bug yellow waste rep.	278,000 cubic yards
L87/91 pad spent ore	7,732,000 cubic yards (mostly from the L87 pad)
Facilities area	137,000 cubic yards
Notch construction	95,000 bank cubic yards
Slope reduction	13,000 cubic yards

The 85-acre graded surface of the pit backfill would be covered with a minimum 21 inches of NAG, 25 inches of soil, and revegetated. A drainage channel would be constructed to pass pit area runoff from a 6.33-inch, 24-hour storm event. After going though the notch and traveling through a channel cut along the east side of the Montana Gulch waste rock dump, runoff from the pit would drain into a lined channel that has already been constructed along an old haul road on the east slope of Montana Gulch. At the L85/86 leach pad excavation area, a riprapped, lined channel would be used to convey the pit runoff down to the reconstructed drainage bottom in Montana Gulch. Two sediment ponds would be constructed on the pit backfill to remove sediment from the runoff before it enters the lined channel.

Four wells would be drilled along the north edge of the pit complex to monitor and potentially recover degraded water that might infiltrate into the Swift Gulch groundwater system. A fifth well would be drilled near the southwest end of the August pit for the same purposes. A pipeline would be constructed to transfer any recovered water from the wells back to the Landusky water treatment plant for processing. A parallel pipeline would be constructed to pump an equal amount of treated water back to the Swift Gulch drainage.

Queen Rose Pit

The floor of the Queen Rose pit would be graded to establish a free draining surface that would slope toward the August/Little Ben pit. The regraded floor would be covered with a geosynthetic liner and then backfilled with 3,107,000 cubic yards of material to cover the sulfide zone in the highwall. Due to the height of the sulfide zone in the Queen Rose pit, 2H:1V slopes would be used along much of its highwall. These slopes would extend down and gradually blend into the contours of the backfilled surface in the August/Little Ben-Suprise pit. The backfill surface would be constructed by building a narrow fill bench near the top of the highwall then dozing the material downhill on a 2H:1V grade. This would cover about half of the highwall and benches in the Queen Rose pit. Material for backfilling this pit would come from the L87 pad (2,873,000 cubic yards) and the L85/86 pad (234,000 cubic yards). Approximately 30 acres of graded backfill would be covered with 21 inches of NAG, 25 inches of soil, and revegetated.

Gold Bug and South Gold Bug Pits

In the later stages of the mining operation the pit was used as a waste repository and partially backfilled. The embankment slopes along the west face of the repository were graded, sealed with a layer of compacted clay, and reclaimed as successive layers of backfill were added. The upper sections of the repository and pit would be graded to produce a free draining surface from the pit highwall to the road. All of the bottom benches would be regraded to create a smooth recontoured surface with maximum 3H:1V slopes. Approximately 100,000 cubic yards of balanced cut/fill grading would be conducted.

Some highwall reduction would be conducted at the north end of the Gold Bug pit to cover exposed sulfide zones with non-acid generating rubble. This would involve stripping soil from 3.58 acres along the ridge top and blasting 93,000 bank cubic yards of NAG material in the stripped area. Bulldozers would push the blasted material over the edge of the highwall, allowing it to pile up along the face of the highwall. The rubble slope would be left at angle of repose. The highwall reduction source area at the top of the ridge would be regraded, covered with 12 inches of soil, and revegetated. An additional 324,000 cubic yards of NAG backfill obtained from the L85/86 pad would be used to cover other sulfide zones around the pit.

After 116,000 cubic yards of the 209,000 cubic yards of limestone in the stockpile has been removed and used either as NAG cover or fill, approximately 69,000 cubic yards of NAG would be hauled in from the L85/86 leach pad to cover sulfides exposed in the highwall. The backfill cover would be placed by building a narrow fill bench near the top of the pit and then dozing the material downhill on a 2H:1V grade. This wedge of NAG backfill would sit on top of the limestone left in the pit. Minor grading would be done to reduce the exposed benches on the west side of the pit to 3H:1V slopes and to tie in the regrade contours. All backfilled and regraded areas in the Gold Bug and South Gold Bug pits (27 acres) would be covered with 21 inches of NAG, 25 inches of soil, and revegetated.

Leach Pad Reclamation

The L85/86 leach pad, liner, and dike would be removed from Montana Gulch. The remaining leach pads in the southwest corner of the mine have been graded to reduce slopes to an overall 3H:1V grade. This reclamation would be considered final. The upper lifts on the west half of the L87 pad would be excavated for pit backfill, leaving a substantial surface area that could be regraded with less than 10% slopes.

Additional reclamation would be conducted on four of the heap retaining dikes. The L85/86 dike would be completely removed. The L84 dike would be built out to a 3H:1V slope using NAG material. Additional revegetation work would be conducted on the L83 and L91 dikes as preventative maintenance.

L79 Leach Pad

The L79 leach pad was reclaimed with 8 to 12 inches of soil and revegetated in September 1991. The existing reclamation would be enhanced with additional fertilization, seeding, and planting.

L80-82, L83, and L84 Leach Pads

Regrading these leach pads was done as part of the 2000 interim reclamation project. Approximately 1.1 million cubic yards of grading and excavation were conducted to recontour these heaps to a final grade of less than 3H:1V. Because the pads were reduced to a height of just over 100 feet, benching was not incorporated into the grading plan. The regrading plan required some offloading of the spent ore onto unlined and partially lined areas adjacent to the pads, and included filling several large depressions between the L80-82 and L83 leach pads and extending the backfill over the upper contingency pond and the process water pond.

Before applying the reclamation cover, the regraded surface was sampled for acid generating potential to a depth of 24 inches on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of King Creek tailings were placed as cover material, followed by 18 inches of soil. The area was seeded in 2001. This interim reclamation would be considered final. However, the existing reclamation on the L83 dike would be improved with additional fertilization, seeding, and planting.

Additional revegetation would be done on the L83 dike. The L84 dike at the north end of the pad complex would be built out to a 3H:1V slope with about 61,000 cubic yards of material borrowed from the L85/86 leach pad. In conjunction with this effort, the over-steepened slope to the south of the dike would be rebuilt using material offloaded from the L80/82 leach pad and the L85/86 leach pad. All of the material used in the dike and slope buildout would be NAG. However, the regraded surfaces would be tested for acid generating potential before applying 24 inches of soil and seeding the reclamation. This interim reclamation would be considered final.

L85/86 Leach Pad

In 2002, the north and west sides of the pad would be excavated to improve drainage around the pad. This material would be used to build out the L84 dike and to recontour the disturbed hillside south and west of the dike with gentle 3H:1V slopes. The leach pad and dike would be removed from the bottom of Montana Gulch to completely unblock drainage through this section of the gulch. Relocation of the access roads through this area would also be required. Pad removal work would include removing all exposed leach pad liner and reconstructing the drainage bottom. In most areas, removal would extend down to the pre-mining surface. The material (2,676,000 cubic yards) would be hauled to a variety of areas around the mine. Due to the steep pre-mining surface below the L84 dike interim reclamation buildout areas, portions of the heap would be left in place to buttress the dike fill. The entire 27.6 acres associated with the pad and dike removal would be covered with 12 inches of soil and revegetated.

L87/91 Leach Pad

Approximately 10,605,000 cubic yards of spent ore would be offloaded from the L87/91 leach pad (primarily from the L87 leach pad) and used to backfill the August/Little Ben, Suprise, and Queen Rose pits. The remainder of the material on the two heaps would be regraded to overall 3H:1V slopes with 40-foot wide benches spaced every 100 vertical feet. The leach pad liner would be extended on the east and west sides so that spent ore could be offloaded into these areas. This would greatly increase the quantity of material that can be dozed downhill to achieve the 3H:1V configuration. The extension of the liner on the southeast side of the L91 leach pad was incorporated into 2000-2001 interim reclamation grading. Excluding the export of spent ore to pit backfill areas, recontouring the pads to 3H:1V slopes would include 1,464,000 cubic yards of bulldozer grading and 102,000 cubic yards of truck/loader redistribution. All of the facilities on the pads, with the exception of the pumping facilities, would be removed before grading. The large pond on the top of the pad would be removed as the spent ore is excavated for pit backfill.

Before placement of the reclamation cover, the regraded surface would be tested for acid generating potential. Lime would be used in the top 24 inches where neutralization is determined to be required. After the surface is prepared, it would be covered with 21 inches of NAG and 25 inches of soil, and the entire L87/91 leach pad area, totaling 202 acres, would be revegetated.

The L87 dike is considered to be reclaimed as it is covered by the Mill Gulch waste rock dump. The 350-foot high L91 dike would be planted with supplementary revegetation to improve erosion resistance and reduce infiltration. Buttressing of the dike is not required as it is stable in its current configuration.

Waste Rock Dump Reclamation

Mill Gulch Waste Rock Dump

The only portion of the Mill Gulch waste rock dump presently unreclaimed is occupied by the Mill Gulch soil stockpile. After all of the soil stored in this facility has been removed from the top of the waste dump, the disturbed area would be regraded and a reclamation cover consisting of 21 inches of NAG and 25 inches of soil would be extended across the newly regraded area on top of the bench. The existing synthetic liner would be extended to cover this area. The previously reclaimed face of the dump would be treated with additional fertilization, seeding, and planting to improve the existing vegetation.

Montana Gulch Waste Rock Dump

A minor amount of excavation for the August/Little Ben Notch would occur along the dump margin but would not extend into the rock dump. The soil stockpile and truck ready-line would be removed. The top of the dump would be covered with 21 inches of NAG material and 25 inches of soil. In those areas where removal of the soil stockpile exposed native ground, 12 inches of soil would be placed. About 6.6 acres on the waste dump and 5.4 acres of the soil stockpile footprint would be revegetated. In the undisturbed areas of the waste rock dump, the existing reclamation would be considered final.

August #1 Waste Rock Dump

The August #1 waste rock dump is spread across several of the topmost benches on the south side of the August/Little Ben pit. Because the August/Little Ben soil stockpile was dumped over the top of the waste rock dump, the two piles are mixed together to some degree.

Material from the two piles would be segregated and used in the reclamation of various areas around the Landusky Mine. Enough of the dump would be left in place to grade the dump and stockpile areas plus an additional 5 acres of adjacent pit benches to 3H:1V slopes. The bench cover would use about 124,000 cubic yards of stockpile material and 6,000 cubic yards of bench reduction. The pit benches to be reclaimed are to the north and below the stockpile. All 15 acres within the stockpile footprint and in the regraded bench area would be covered with 24 inches of soil and revegetated.

August #2 Waste Rock Dump

The west lobe of the August #2 waste rock dump has been graded to blend into the natural terrain and covered with 8 to 12 inches of soil. Trees were planted on this lobe in April 1990 and again in April 1991. This existing reclamation on the west lobe of the dump would be considered final.

The east lobe, containing about 599,000 cubic yards of material, sits on the north wall of the August/Little Ben pit. This lobe was covered with 8 to 12 inches of soil and revegetated in May 1992. The material in this dump is non-acid generating. The existing soil and vegetation would be stripped and the east lobe of the dump would be completely removed and used for NAG fill and cover. After this dump has been removed, the exposed slopes would be covered with 12 inches of soil and revegetated. The King Creek-to-Zortman access road would be relocated through the dump footprint.

Gold Bug Yellow Waste Rock Repository

The entire Gold Bug yellow waste rock repository would be removed. About 255,000 cubic yards of the material would be buried deep in the August/Little Ben backfill. The remaining 27,000 cubic yards would be used to cover exposed sulfides on the upper mining bench in the northeast corner of the stockpile area. After removing the stockpile, an intermediate bench covered by the stockpile would be blasted and reduced to 3H:1V slopes. About 22,500 cubic yards of the bench material would be graded over the August/Little Ben highwall. The remainder would be contoured to form a free draining surface. The 13.3-acre regraded area would be covered with 21 inches of NAG material, 25 inches of soil, and revegetated.

Lower Gold Bug Blue Waste Rock Stockpile

The material in the lower Gold Bug blue waste rock stockpile is non-acid generating and would be removed for use in construction of the reclamation covers. The remaining footprint would be covered with 24 inches of soil and revegetated.

Upper Gold Bug Blue Waste Rock Stockpile

The material in the upper Gold Bug blue waste rock stockpile is non-acid generating and would be removed for use in construction of the reclamation covers. The remaining footprint would be covered with 12 inches of soil and revegetated.

Support Facilities Reclamation

All of the mining-related facilities not associated with water treatment would be removed, their footprints covered with 12 inches of soil, and revegetated. These facilities include the fuel farm, upper warehouse, maintenance shop, lower Merrill-Crowe plant, three carbon plants, and the Landusky guard shack and gate. The upper Merrill-Crowe plant would be left for use in the biological treatment process.

The water treatment plant, drainage capture systems, ponds, and associated structures would be left intact and continue functioning where presently located until no longer needed. Once removed, their footprints would be regraded, covered with soil, and revegetated.

Alternative L6, Total Backfill and Topography Restoration

Alternative L6 would cost more than eight times the available reclamation bond amount. It would backfill the pit areas to restore the approximate pre-mining topography and re-establish the north-south drainage divide. Reclaimed surfaces would be covered with a low permeability water barrier cover or low infiltration water balance cover. The reclamation for each mine feature is shown in Figure 2.4-14. Those mine features that would be considered already reclaimed and not receiving additional reclamation work under this alternative are labeled "No Action" or "Reclaimed in 2000-2001."

Mine Pit Reclamation

August/Little Ben, Suprise, and Queen Rose Pit Complex

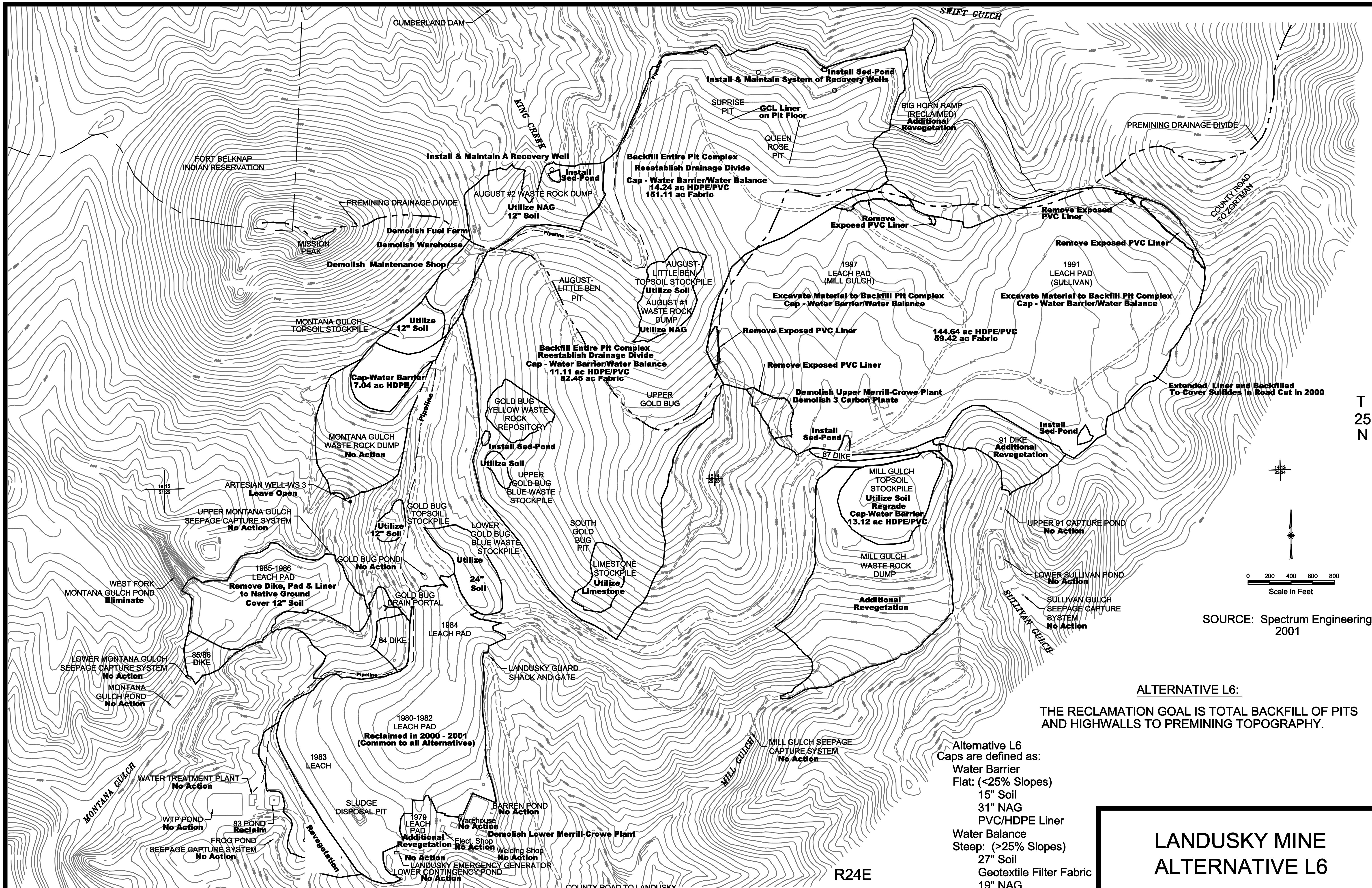
The August/Little Ben, Suprise, and Queen Rose pits would be completely backfilled with nearly 42 million cubic yards of material. The estimated earthwork quantities that would go into these pits are as follows:

L85/86 leach pad and dike	1,533,000 cubic yards
L87/91 leach pad	38,414,000 cubic yards
Montana Gulch waste rock dump	1,015,000 cubic yards
Facilities area	277,000 cubic yards
Highwall reduction	873,000 cubic yards

Prior to backfilling, the pit floor would be graded and covered with a geosynthetic liner to direct infiltrating water to the south. The backfilled surface would be graded to a configuration that restores the original drainage divides, allowing all surfaces to drain freely in the same direction as they did prior to 1979. However, the surface configuration would not restore the changes to the groundwater flow made by the old underground workings. The original contour of the pit area had slopes averaging 2H:1V to 2.8H:1V. These would be replaced with slopes of 3H:1V with 25-foot wide benches at 100 foot vertical intervals in order to maintain stability.

The regraded slopes would be covered with 46-inch thick water barrier (14.24 acres) and water balance (151.11 acres) reclamation covers which incorporate geosynthetic liner or geotextile filter fabric, depending on the slope grade. Within the August/Little Ben-Suprise-Queen Rose pit complex, 165.3 acres would be revegetated.

Four wells would be drilled along the north edge of the Suprise pit to monitor and potentially recover degraded water that might infiltrate the Swift Gulch groundwater system. A fifth well would be drilled in the bottom of King Creek to recover any pit water infiltrating into the King Creek drainage. A pipeline would be constructed to transfer any recovered water back to the Landusky water treatment plant for processing. A parallel pipeline would be constructed to pump an equal amount of treated water back to the Swift Gulch or King Creek drainages.



CUMBERLAND DAM
SWIFT GULCH
KING CREEK
Pipeline
Install Sed-Pond
Install & Maintain System of Recovery Wells
SUPRISE PIT
GCL Liner on Pit Floor
BIG HORN RAMP (RECLAIMED)
Additional Revegetation
QUEEN ROSE PIT
PREMINING DRAINAGE DIVIDE
FORT BELKNAP INDIAN RESERVATION
Install & Maintain A Recovery Well
Install Sed-Pond
Backfill Entire Pit Complex
Reestablish Drainage Divide
Cap - Water Barrier/Water Balance
14.24 ac HDPE/PVC
151.11 ac Fabric
AUGUST #2 WASTE ROCK DUMP
Utilize NAG
12" Soil
PREMINING DRAINAGE DIVIDE
MISSION PEAK
Demolish Fuel Farm
Demolish Warehouse
Demolish Maintenance Shop
Remove Exposed PVC Liner
Remove Exposed PVC Liner
COUNTY ROAD TO ZORTMAN
Remove Exposed PVC Liner
AUGUST-LITTLE BEN TOPSOIL STOCKPILE
Utilize Soil
AUGUST #1 WASTE ROCK DUMP
Utilize NAG
AUGUST-LITTLE BEN PIT
1987 LEACH PAD (MILL GULCH)
1991 LEACH PAD (SULLIVAN)
Excavate Material to Backfill Pit Complex
Cap - Water Barrier/Water Balance
Excavate Material to Backfill Pit Complex
Cap - Water Barrier/Water Balance
MONTANA GULCH TOPSOIL STOCKPILE
Utilize 12" Soil
Remove Exposed PVC Liner
144.64 ac HDPE/PVC
59.42 ac Fabric
Backfill Entire Pit Complex
Reestablish Drainage Divide
Cap - Water Barrier/Water Balance
11.11 ac HDPE/PVC
82.45 ac Fabric
Remove Exposed PVC Liner
Cap-Water Barrier
7.04 ac HDPE
Extended Liner and Backfilled To Cover Sulfides in Road Cut in 2000
UPPER GOLD BUG
Demolish Upper Merrill-Crowe Plant
Demolish 3 Carbon Plants
GOLD BUG YELLOW WASTE ROCK REPOSITORY
T 25 N
Install Sed-Pond
Install Sed-Pond
MONTANA GULCH WASTE ROCK DUMP
No Action
Install Sed-Pond
91 DIKE
Additional Revegetation
87 DIKE
Utilize Soil
UPPER GOLD BUG BLUE WASTE STOCKPILE
MILL GULCH TOPSOIL STOCKPILE
Utilize Soil
Regrade
Cap-Water Barrier
13.12 ac HDPE/PVC
ARTESIAN WELL-WS 3
Leave Open
UPPER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
GOLD BUG TOPSOIL STOCKPILE
Utilize 12" Soil
LOWER GOLD BUG BLUE WASTE STOCKPILE
SOUTH GOLD BUG PIT
UPPER 91 CAPTURE POND
No Action
GOLD BUG POND
No Action
Utilize 24" Soil
LIMESTONE STOCKPILE
Utilize Limestone
MILL GULCH WASTE ROCK DUMP
LOWER SULLIVAN POND
No Action
0 200 400 600 800
Scale in Feet
1985-1986 LEACH PAD
Remove Dike, Pad & Liner to Native Ground
Cover 12" Soil
WEST FORK MONTANA GULCH POND
Eliminate
GOLD BUG DRAIN PORTAL
SULLIVAN GULCH
SULLIVAN GULCH SEEPAGE CAPTURE SYSTEM
No Action
Additional Revegetation
SOURCE: Spectrum Engineering 2001
84 DIKE
1984 LEACH PAD
85/86 DIKE
LOWER MONTANA GULCH SEEPAGE CAPTURE SYSTEM
No Action
LANDUSKY GUARD SHACK AND GATE
MONTANA GULCH POND
No Action
ALTERNATIVE L6:
THE RECLAMATION GOAL IS TOTAL BACKFILL OF PITS AND HIGHWALLS TO PREMINING TOPOGRAPHY.
1980-1982 LEACH PAD
Reclaimed in 2000 - 2001 (Common to all Alternatives)
MILL GULCH
MILL GULCH SEEPAGE CAPTURE SYSTEM
No Action
1983 LEACH
MONTANA GULCH
WATER TREATMENT PLANT
No Action
Alternative L6
Caps are defined as:
Water Barrier
Flat: (<25% Slopes)
15" Soil
31" NAG
PVC/HDPE Liner
Water Balance
Steep: (>25% Slopes)
27" Soil
Geotextile Filter Fabric
19" NAG
SLUDGE DISPOSAL PIT
BARREN POND
No Action
WTP POND
No Action
83 POND
Reclaim
1979 LEACH PAD
Additional Revegetation
Warehouse
No Action
Demolish Lower Merrill-Crowe Plant
FROG POND SEEPAGE CAPTURE SYSTEM
No Action
Revegetation
Elect. Shop
No Action
Welding Shop
No Action
No Action
LANDUSKY EMERGENCY GENERATOR
LOWER CONTINGENCY POND
No Action
COUNTY ROAD TO LANDUSKY
R24E
LANDUSKY MINE
ALTERNATIVE L6

FIGURE 2.4-14

Gold Bug and South Gold Bug Pits

During the later stages of the mining operation, the South Gold Bug pit was used to stockpile limestone. This stockpile would be used for NAG fill and cover, after which both pits would be completely backfilled as part of the full restoration of the entire pit complex. The Gold Bug pit area backfill would be obtained partially from highwall reduction (1,022,000 cubic yards) and partially by importing 8,740,000 cubic yards from the L85/86 and L87/91 leach pads. The backfill would be graded to a configuration that restores the original surface drainage pattern. The original contour of the pit area had slopes averaging 2.2H:1V to 2.6H:1V. These would be replaced with slopes of 3H:1V with 25-foot wide benches at 100 foot vertical intervals in order to maintain stability.

The regraded slopes would be covered with 46-inch thick water barrier (11.11 acres) and water balance (82.45 acres) reclamation covers which incorporate geosynthetic liner or geotextile fabric, depending on the slope. Revegetation within the Gold Bug pit would take place on 93.6 acres. The previously reclaimed areas along the west side of the pit would not be affected by this alternative.

Leach Pad Reclamation

The L85/86 leach pad, dike and liner would be removed from Montana Gulch. The native ground would be covered with 12 inches of soil and revegetated. The interim reclamation on the L80-82, L83 and L84 leach pads would be considered final. A large amount of spent ore from the L87/91 leach pad would be used for pit backfill. The remaining spent ore would be regraded and covered with either a water barrier or water balance reclamation cover.

The L85/86 dike would be removed. The L84 dike would be built out to 3H:1V slopes. Additional revegetation would occur on the L83 and L91 dikes as a preventative maintenance measure.

L79 Leach Pad

The L79 leach pad was reclaimed with 8 to 12 inches of soil and revegetated in September 1991. The existing reclamation would be enhanced with additional fertilization, seeding, and planting.

L80-82, L83, and L84 Leach Pads

Regrading these leach pads was undertaken as part of the 2000 interim reclamation project. Approximately 1.1 million cubic yards of grading and excavation were conducted to recontour these heaps to overall slopes of 3H:1V or flatter. Because the pads were reduced to a height of just over 100 feet, benching was not incorporated into the regrading.

The regrading included some offloading of the spent ore onto unlined and partially lined areas adjacent to the pads, and included filling several large depressions between the L80-82 and L83 leach pads and extending the backfill over the upper contingency pond and the process water pond.

Before applying the reclamation cover, the regraded surface was sampled for acid generating potential to a depth of 24 inches on a grid spacing of 100 feet. Grids with a net acid potential were neutralized with lime. After liming, 6 inches of King Creek tailings were placed as cover material, followed by 18 inches of soil. The area was seeded in 2001. This interim reclamation would be considered final.

Additional revegetation work would be conducted on the L83 dike. The L84 dike at the north end of the leach pad complex would be built out to a 3H:1V slope with about 61,000 cubic yards of NAG material from the L85/86 leach pad. The regraded dike would be covered with 24 inches of soil and revegetated.

<u>L85/86 Leach Pad</u>

In 2002, the north and west sides of the pad would be excavated to improve interim drainage around the pad. This material would be used to build out the L84 dike and recontour the disturbed hillside south and west of the dike to a gentle 3H:1V slope.

The spent ore blocking this section of Montana Gulch would be removed. In most areas, removal would extend down to the pre-mining surface. Pad removal work would include removing all exposed leach pad liner and reconstructing the drainage bottom. Most of the material (2,569,000 cubic yards) would be hauled to pit backfill areas or would be used as NAG cover (107,000 cubic yards). Due to the steep pre-mining surface below the interim reclamation buildout areas, portions of the heap would be left in place to buttress these fills. The access road through this area would be relocated.

The area associated with the pad and dike removal would be covered with 12 inches of soil and revegetated. The slope buildout area would be covered with 24 inches of soil and revegetated.

<u>L87/91 Leach Pad</u>

An estimated 22,732,000 cubic yards of spent ore from the L87 leach pad and 23,386,000 cubic yards of spent ore from the L91 leach pad would be offloaded and used for pit backfill. The remainder of the material on the two heaps would be regraded to 3H:1V slopes. The excavation and grading would approximate the shape of the pre-mining drainages, although not at the original elevations. Complex slopes and small draws would be incorporated into the regraded surface instead of using benches.

The leach pad liner would be extended on the east and west sides so that pad material could be offloaded into these areas. The extension of the liner on the southeast side of the L91 leach pad was incorporated into the 2000-2001 interim reclamation grading. Excluding the export of spent ore to pit backfill areas, recontouring the pads would require 174,000 cubic yards of bulldozer grading.

After regrading, the surface would be tested for acid generating potential. Lime would be incorporated in the top 24 inches where neutralization is determined necessary. The regraded surface on both pads would be covered with 46-inch thick water barrier (144.64 acres) and water balance (59.42 acres) reclamation covers that incorporate a geosynthetic liner or geotextile filter fabric, depending on the slope steepness. Within the L87/91 leach pad area, 204.1 acres would be revegetated. All of the processing facilities on the leach pads would be removed except for the pumping facilities. The large pond on the top of the L87 leach pad would be removed as the top of the pad was excavated for pit backfill.

The L87 dike would be considered to be reclaimed as it is covered by the Mill Gulch waste rock dump. The 350-foot high L91 dike would be planted with supplementary revegetation to improve surface stability.

Waste Rock Dump Reclamation

Mill Gulch Waste Rock Dump

The only portion of the Mill Gulch waste rock dump presently unreclaimed is occupied by the Mill Gulch soil stockpile. After all of the soil stored in the stockpile has been removed from the top of the dump, the disturbed area would be regraded and the water barrier cover installed on the dump top would be extended across the stockpile footprint. The previously reclaimed face of the dump would be treated with additional fertilization, seeding, and planting to improve the existing vegetation.

Montana Gulch Waste Rock Dump

The soil stockpile and truck ready-line would be removed from the top of the dump. The disturbed area would be regraded and a water barrier cover consisting of a geosynthetic liner, 31 inches of NAG, and 15 inches of soil would be installed over the 7-acre dump top. In those areas where removal of the soil stockpile exposed native ground (5.6 acres), 12 inches of soil would be placed. In the undisturbed areas of the waste rock dump, the existing reclamation would be considered final.

August #1 Waste Rock Dump

The August #1 waste rock dump is spread across several of the topmost benches on the south side of the August/Little Ben pit. Because the August/Little Ben soil stockpile was dumped over the top of the waste dump, the two piles are mixed together to some degree. The material from the two piles would be segregated and used in the reclamation of various areas around the Landusky Mine. This dump area would be covered by the mine pit backfill.

August #2 Waste Rock Dump

The west lobe of the August #2 waste rock dump has been graded to blend into the natural terrain and covered with 8 to 12 inches of soil. Trees were planted on this lobe in April 1990 and again in April 1991.

The east lobe, containing about 599,000 cubic yards of material, sits on the north wall of the August/Little Ben pit. This lobe was covered with 8 to 12 inches of soil and revegetated in May 1992.

The material in both lobes of the dump is non-acid generating. The soil would be salvaged off both lobes and the waste rock utilized for NAG cover in various areas. After the entire dump has been removed, the exposed slopes would be covered with 12 inches of soil and revegetated. The King Creek-to-Zortman access road would be relocated through the dump footprint.

Gold Bug Yellow Waste Rock Repository

The Gold Bug yellow waste rock repository is situated on a mine bench between the Gold Bug pit and the August/Little Ben pit and has been characterized as a potential acid producer. The waste rock would be left in place and covered by mine pit backfill.

Lower Gold Bug Blue Waste Rock Stockpile

The material in the lower Gold Bug blue waste rock stockpile is non-acid generating and would be used in construction of the reclamation covers. The remaining footprint would be covered with 24 inches of soil and revegetated.

Upper Gold Bug Blue Waste Rock Stockpile

The material in the upper Gold Bug blue waste rock stockpile is non-acid generating and would be removed and used in construction of the reclamation covers. The remaining footprint would be buried under the mine pit backfill.

Support Facilities Reclamation

All of the mining-related facilities not associated with water treatment would be removed, their footprints covered with 12 inches of soil, and revegetated. These facilities include the fuel farm, upper warehouse, maintenance shop, lower Merrill-Crowe plant, three carbon plants, and the Landusky guard shack and gate. The upper Merrill-Crowe plant would be left for use in the biological treatment process.

The water treatment plant, drainage capture systems, ponds, and associated structures would be left intact and continue functioning where presently located until no longer needed. Once removed, their footprint would be regraded, covered with soil, and seeded. The pumping facilities on the L91 pad would be disrupted by the excavation. After excavation, these facilities would be rebuilt at a substantially lower elevation on the regraded surface.

2.5 CUMULATIVE ACTIONS

Other actions in the area of the Little Rocky Mountains include the reclamation of exploration roads and clay pits, the tailings removal action in King Creek by EPA, and removal of the old mine tailings in the Ruby Gulch drainage. These actions could occur independent of mine reclamation.

2.6 PREFERRED ALTERNATIVE IDENTIFICATION

As part of the environmental analysis process, the agencies are required to identify, when one exists, the preferred alternative in the draft and final EIS. The identification of a preferred alternative does not constitute a decision to select that alternative for implementation. The purpose of identifying a preferred alternative is to let the public know which way the agencies are leaning, at this point in the analysis, so the public can focus on the alternative(s) that are likely to be selected.

No sooner than 30 days after the Final SEIS has been released, a Record of Decision (ROD) will be prepared that actually *selects* the reclamation alternatives to be implemented and provides a detailed rationale for that selection. The alternatives selected in the ROD, and their manner of implementation, may change slightly from that described in the preferred alternative of the Final SEIS. Such changes could be the result of additional mitigation development, policy direction, or budget constraints (see also, 1996 FEIS Section 2.4).

2.6.1 Preferred Alternatives

At this time the agencies have identified Alternative Z6 for reclamation of the Zortman Mine and Alternative L4 for reclamation of the Landusky Mine as the preferred alternatives. These are the alternatives the agencies believe would best address the purpose and need to reclaim the mines with a reasonable assurance for long-term success in meeting the State and Federal requirements for mine reclamation, while protecting human health, the environment, and trust resources.

Reclamation using Alternative Z6, at the Zortman Mine, would revegetate disturbed areas, isolate or control toxic or deleterious materials, and cover virtually all of the sulfide portions of the mine pit highwalls with backfill. Alternative Z6 avoids the potentially negative impacts of additional backfill placement in drainages which flow toward the north, thus protecting Tribal water resources.

Reclamation using Alternative L4, at the Landusky Mine, would also revegetate disturbed areas, isolate or control toxic or deleterious materials, and cover approximately 85% of the sulfide portions of the mine pit highwalls with backfill or rubble slopes. Alternative L4 would take all the readily available, relatively non-acid generating material and use it as backfill in the mine pits. Alternative L4 would avoid the potential negative impacts on the drainages to the north of the mine that would occur with the use of spent ore from the L87/91 leach pad as backfill. In addition, Alternative L4 would remove the L85/86 leach pad, which is obstructing the Montana Gulch drainage, and through highwall reduction would reduce the visual impact of the mine pit highwalls that would remain after partial backfilling.

Several comments collected on the Draft SEIS questioned at length the preference of Alternative L4 over Alternative L5. To more clearly explain the differences and similarities between the two alternatives in terms of performance and impacts, a side-by-side comparison based upon the analysis in the Final SEIS is provided in Table 2.6-1.

Table 2.6-1. Comparison of Alternatives L4 and L5

Alternative L4 (Preferred)	Alternative L5
Estimated Cost: $37.1 million (almost double the reclamation bond)	Estimated Cost: $68.5 million (more than triple the reclamation bond)
Amount/type of pit backfill: 2.6 Myd^3 from the L85/86 leach pad (non-acid forming material)	Amount/type of pit backfill: 2.3 Myd^3 from the L85/86 leach pad (non-acid forming material) 10.6 Myd^3 from the L87 leach pad (acid forming)
"Sulfide-rich" portion of the pit highwalls covered with backfill: ~85% (100% north side of divide)	"Sulfide-rich" portion of the pit highwalls covered with backfill: ~100%
Post-reclamation highwalls: Several hundred vertical feet of highwall visible from a distance. Pit configuration: Still visible to site visitors.	Post-reclamation highwalls: Several hundred vertical feet of highwall visible from a distance. Pit configuration: Low visibility to site visitors.
Amount of disturbance area revegetated: 81%	Amount of disturbance area revegetated: 85%
Minewide estimated infiltration: 289 gpm	Minewide estimated infiltration: 287 gpm
Reduction from existing infiltration rate: 61%	Reduction from existing infiltration rate: 62%
Pit area estimated infiltration: 89 gpm	Pit area estimated infiltration: 84 gpm
Reduction from existing pit infiltration rate: 54%	Reduction from existing pit infiltration rate: 57%
Sulfate load to Swift Gulch: decreases by 36%	Sulfate load to Swift Gulch: increases by 66%
Number Long-term Seepage Capture Systems Required: Four, same as existing.	Number Long-term Seepage Capture Systems Required: Additional system in Swift Gulch.
Estimated Northern Drainage Basin Contaminant Loads	
Sulfate Load (lbs/year): King Creek: 64,000 Swift Creek: 54,000	Sulfate Load (lbs/year): King Creek: 151,000 Swift Creek: 141,000

Alternative L4 (Preferred)	Alternative L5
Iron Load (lbs/year): King Creek: 26 Swift Creek: 900	Iron Load (lbs/year): King Creek: 60 Swift Creek: 1,300
Aluminum Load (lbs/year): King Creek: 17 Swift Creek: 20	Aluminum Load (lbs/year): King Creek: 130 Swift Creek: 110
Zinc Load (lbs/year): King Creek: 6 Swift Creek: 40	Zinc Load (lbs/year): King Creek: 66 Swift Creek: 100
Arsenic Load (lbs/year): King Creek: 1 Swift Creek: 3	Arsenic Load (lbs/year): King Creek: 1 Swift Creek: 4
Copper Load (lbs/year): King Creek: 1 Swift Creek: 0	Copper Load (lbs/year): King Creek: 5 Swift Creek: 3
Cadmium Load (lbs/year): King Creek: 0 Swift Creek: 0	Cadmium Load (lbs/year): King Creek: 1 Swift Creek: 1
Multiple Accounts Analysis (MAA) Scores (scale of 1 to 9)	
Technical Working Group Score: 7.2 (includes all accounts)	Technical Working Group Score: 7.2 (includes all accounts)
Technical Working Group Score: 7.3 (environmental performance only)	Technical Working Group Score: 7.9 (environmental performance only)
Technical Working Group Score: 9.0 (Swift Gulch groundwater protection score)	Technical Working Group Score: 5.0 (Swift Gulch groundwater protection score)
MAA Cost-Benefit Score: 4.2 (environmental performance/reclamation $)	MAA Cost-Benefit Score: 3.2 (environmental performance/reclamation $)

The main reason Alternative L4 is identified as preferred over Alternative L5 is that the extra backfill needed to implement Alternative L5 would have to be obtained by moving cyanidated and acid generating materials off the lined L87/91 leach pads, located in an area that drains away from the Fort Belknap Reservation, and placing that material at the head of drainages that flow toward the Reservation. This creates an inherently greater risk to Tribal water resources that cannot be mitigated below significance.

The L87/91 leach pads are constructed in a bowl-shaped lined containment area at the heads of Mill Gulch and Sullivan Gulch. The liner beneath these leach pads consists of two feet of compacted clay overlain by a 30 mil PVC synthetic liner. The containment area is sloped to the south so that water infiltrating through the rock on the leach pad collects along the liner and is directed to sumps in the ponded area at the base of the leach pads in upper Mill and Sullivan Gulches. This water is then treated and released as part of mine reclamation under Alternative L4. The liner systems beneath the L87 and L91 leach pads appear to be functioning quite well. Should these liners fail at some point in the future the contaminated leachate would migrate down Mill Gulch or Sullivan Gulch where it could be intercepted by the capture system. Any contamination that was not recovered by the capture system would continue to flow toward the south and away from the Fort Belknap Reservation.

Contrast the above scenario under Alternative L4 to what could happen under Alternative L5 (or L6). The material on the L87/91 leach pad is known to be acid generating. A large portion of this material would be removed from the L87/91 pad (10.6 or 38.4 million cubic yards, under Alternative L5 or L6, respectively) and placed in the mine pits. Despite placement of a synthetic liner over the pit floor some of the backfill material would have to be located off-liner, buttressed against the highwalls. Nor is there any way to guarantee the liner would function adequately or indefinitely. The backfill material would overlay the August Shear Zone which provides a groundwater recharge conduit to Swift Gulch. Some of the precipitation that falls on the backfilled mine pits would infiltrate into the mine waste and generate acidic drainage with elevated metal content. Contaminated leachate bypassing the pit liner would enter the groundwater system beneath the northern half of the pit and eventually reappear in Swift Gulch as contaminated surface flow. While groundwater recovery wells would be installed north of the backfilled pit under Alternative L5, it is not likely that all the contaminated groundwater could be recovered due to the difficulty of intercepting flow in fractured bedrock. Construction of effective capture systems in Swift Gulch to intercept seepage would also be extremely difficult due to the presence of a number of small seeps spread out over a large reach of the stream. In addition, the construction activity itself would create considerable surface disturbance in this steep-sided valley.

Stated another way, contaminated groundwater is much more likely to escape capture as it enters Swift Gulch than similar waters entering Mill Gulch or Sullivan Gulch, and would discharge toward the Fort Belknap Reservation. Thus, despite the best engineering controls, placement of acid generating material in the mine pits north of the Swift Gulch-Montana Gulch groundwater divide creates the potential for substantial impacts to Tribal water resources which cannot be mitigated below significance. Alternative L4 is preferred over Alternative L5, since it uses only the relatively non-acid generating material for backfill without creating significant increased risk to water quality. In fact, the removal of the L85/86 leach pad from Montana Gulch would have a positive impact on water quality by unblocking that drainage. At the same time, use of the L85/86 material as backfill would have a positive impact on groundwater beneath the pit area by covering up the sulfide-rich portion of the highwalls that might release contaminants. Table 2.6-1 shows how the contaminant loads are anticipated to increase under Alternative L5 in the northern-flowing drainages, especially in Swift Gulch, with the placement of material from the L87/91 leach pad in the pit area.

Nor would the environmental performance of Alternative L5 necessarily be superior to Alternative L4 as it relates to controlling sulfide reactivity in the pit highwalls. The amount of sulfide-rich highwall that would be covered by Alternative L4 is estimated at 85% overall. The remaining 15% of sulfidic highwall would be in those portions of the highwalls located south of the drainage divide, away from Fort Belknap, and consist of relatively low reactive rock faces. While Alternative L5 would cover 100% of the sulfide-rich highwalls, it would do so with broken acid generating rock, which has orders of magnitude greater reactivity than a solid rock face. This would offset any environmental advantage of covering the last 15% of the sulfide-rich highwall rock faces under Alternative L5.

Visually, the main difference between Alternatives L4 and L5 is that under Alternative L5 the pit type configuration would be filled to more closely resemble a large bench or shallow valley. However, the amount of highwall visible to viewers outside the immediate mining area would be the same under both alternatives. Neither alternative would restore the aesthetics of the area to pre-mining conditions.

When comparing the overall MAA scores of Alternatives L4 and L5, there is no substantial difference. The results are within the range of accuracy for the MAA technique. Furthermore, the MAA process intentionally did not include all the legal factors that will be used to select a preferred alternative such as the potential for impacts to trust resources. The MAA scores of indicators which may be used as a proxy for trust resources, such as impacts to Swift Gulch, show that Alternative L4 has a considerable advantage over Alternative L5 in protection of water quality.

In summary, it has been suggested that the reclamation cost has driven the preferred alternative identification. However, if that were the case the agencies would have identified preferred alternatives that were within the available reclamation bond amount rather than alternatives that will cost approximately $34 million in additional funds. Although cost is certainly a concern, of more importance is the limited amount of relatively clean material available for use as pit backfill. While the MAA scoring shows that the two alternatives have roughly the same *overall* environmental performance, this overall scoring masks some large disadvantages of Alternative L5, notably its potential to negatively impact American Indian trust resources. When the potential negative impacts to trust resources are considered in combination with the increased cost of Alternative L5 (almost twice that of Alternative L4), the identification of Alternative L4 as the preferred alternative is justified.

2.6.2 Implementation and Additional Preferred Alternatives

Selection and implementation of Alternatives Z6 and L4 are dependent upon adequate funding. At this time it is estimated that Alternative Z6 would cost approximately $5 million more than is available under the existing reclamation bond, and Alternative L4 would cost approximately $17 million more than is available under the existing reclamation bond. Should the additional funding needed to implement these alternatives not be forthcoming in the next several years, the agencies have identified other preferred alternatives that would be implemented within the existing reclamation bond amounts. These additional preferred alternatives are Alternative Z3, for reclamation of the Zortman Mine; and Alternative L3, for reclamation of the Landusky Mine.

Alternatives Z3 and L3 would also meet the basic purpose and need to reclaim the mines with a reasonable assurance for long-term success in meeting the State and Federal requirements for mine reclamation, while protecting human health, the environment, and trust resources. However, these alternatives would require greater long-term active management in order to maintain resource protection, and would not address the aesthetic and environmental considerations associated with the pit highwalls as well as Alternatives Z6 and L4. Should it be necessary to select Alternatives Z3 and L3, their implementation would not preclude the addition of the preferred reclamation features contained in Alternatives Z6 and L4 at a later date if funding became available.

2.7 ALTERNATIVE COMPARISON TABLES

The following tables compare the major provisions of the alternatives considered in detail. Table 2.7-1 shows the components of the six alternatives for reclamation of the Zortman Mine. Table 2.7-2 shows the components of the six alternatives for reclamation of the Landusky Mine.

Table 2.7-1. Zortman Mine Reclamation Alternatives Comparison

Mine Feature ***Interim Reclamation Action***	***Alternative Z1*, Existing DEQ Reclamation Plans (FEIS Alt. 3 & 1998 ROD)**	***Alternative Z2*, Optimized Water Treatment within Bond Amounts**	***Alternative Z3*, Optimize Source Control within Bond Amounts**	***Alternative Z4*, Added Backfilling with Barrier Reclamation Covers**	***Alternative Z5*, Extensive Backfilling with Soil Reclamation Covers**	***Alternative Z6* Optimize Grading for Source Control (Preferred Alt.)**
General Reclamation Cover Description (see also Figure 2.4-1):						
Water Barrier Cover	Use on slopes flatter than 4H:1V over 24" neutral waste. Place a GCL, 36" NAG/ subsoil, 12" soil, and revegetate.	Used in backfilled pit area. 24" neutral waste, geosynthetic membrane liner, 36" NAG/ tailings, 12" soil, and revegetate.	Same as Alt. Z3.	Same as Z1 cover, but use geosynthetic membrane such as HDPE or PVC instead of GCL in cover construction.	Use on slopes flatter than 4H:1V. Place geosynthetic liner, 24"NAG, 10" Ruby tailings, 8" soil, and revegetate.	Use on slopes flatter than 4H:1V. Place geosynthetic liner, 24"NAG, 12" Ruby tailings, 12" soil, and revegetate.
Water Balance Cover	Use on slopes steeper than 4H:1V. Place 12" NAG, geotextile filter fabric, 36" soil, and revegetate.	Not used.	Not used.	Use on slopes steeper than 4H:1V. Place 36" NAG, geotextile filter fabric, 12" soil, and revegetate.	Use on slopes steeper than 4H:1V. Place 12" NAG, geotextile filter fabric, 24" Ruby tailings, 8" soil, and revegetate.	Use on slopes steeper than 4H:1V. Place 12" NAG, geotextile filter fabric, 12" Ruby tailings, 12" soil, and revegetate.
Soil Cover *24" NAG by lime amendment, 6" tailings, & 18" soil*	12" NAG and 12" soil over acid generating footprints or native ground. 12" soil over non-acid generating surfaces. Revegetate entire cover.	12"-24" NAG and 12" soil over acid genera-ting materials or native ground. 12" soil over non-acid generating areas. Revegetate entire cover.	12"-24" NAG, 0"-7" Ruby tailings, and 12" soil over acid genera-ting materials or native ground. 12" soil over non-acid generating areas. Revegetate entire cover.	Same as Alt. Z1.	12"-24" NAG, 10" Ruby tailings, and 8" soil over acid genera-ting footprints or native ground. 8"soil or 10" Ruby tailings and 8" soil over non-acid generating areas. Revegetate cover.	6" Ruby tailings, and 18" soil over regraded surfaces. Test all areas for acid generating potential to depth of 24" and lime as required. Revegetate entire cover.

Mine Feature ***Interim Reclamation Action***	***Alternative Z1*, Existing DEQ Reclamation Plans (FEIS Alt. 3 & 1998 ROD)**	***Alternative Z2*, Optimized Water Treatment within Bond Amounts**	***Alternative Z3*, Optimize Source Control within Bond Amounts**	***Alternative Z4*, Added Backfilling with Barrier Reclamation Covers**	***Alternative Z5*, Extensive Backfilling with Soil Reclamation Covers**	***Alternative Z6* Optimize Grading for Source Control (Preferred Alt.)**
Mine Pits:						
O.K./Ruby Pit *Cut notch in east highwall and backfill with Z82 and Z85/86 leach pads to be free draining.*	Backfill with Alder Gulch waste rock dump to make pit free draining; Cover backfill with water barrier and water balance reclamation covers.	Backfilled by interim reclamation. Cover backfill with 6" clay, PVC liner, 24" NAG, 12" soil, and revegetate.	Same as Alt. Z2. Cover backfill with 6" clay, PVC liner, 24" NAG, 7" Ruby tailings, 11" soil, and revegetate.	Same as Alt. Z2. Cover with water barrier and water balance reclamation covers.	Completely backfill pit to approximate original contour. Cover with water barrier and water balance reclamation covers.	Same as Alt. Z2. Cover backfill with 6" clay, PVC liner, 24" NAG, 12" Ruby tailings, 12" soil, and revegetate.
Mint Pit *Backfill to be free draining*	Backfilled by interim reclamation. Cover with water barrier reclamation cover.	Backfilled by interim reclamation. Cover backfill with 6" clay, PVC liner, 24" NAG, 12" Ruby tailings, 12" soil, and revegetate.	Backfilled by interim reclamation. Cover backfill with 6" clay, PVC liner, 24" NAG, 12" Ruby tailings, 12" soil, and revegetate.	Backfilled by interim reclamation. Cover with water barrier and water balance reclamation covers.	Completely backfill pit to approximate original contour. Cover with 24" NAG, 10" Ruby tailings, 8" soil, and revegetate.	Backfilled by interim reclamation. Lime amend top 24" of fill to NAG. Cover with 6" Ruby tailings, 18" soil, and revegetate.
North Alabama Pit	Minor grading to be free draining. Cover pit floor with water barrier reclamation cover.	Minor grading to be free draining. Cover with 12" soil only and revegetate.	Same as Alt. Z2.	Almost totally backfilled. Cover with water barrier and water balance reclamation covers.	Completely backfill pit to approximate original contour. Cover with 10" Ruby tailings, 8" soil and revegetate.	Fill to top of north pit wall with material from Alder Gulch waste rock dump. Cover backfill surface with water barrier reclamation cover.

Mine Feature ***Interim Reclamation Action***	***Alternative Z1*, Existing DEQ Reclamation Plans (FEIS Alt. 3 & 1998 ROD)**	***Alternative Z2*, Optimized Water Treatment within Bond Amounts**	***Alternative Z3*, Optimize Source Control within Bond Amounts**	***Alternative Z4*, Added Backfilling with Barrier Reclamation Covers**	***Alternative Z5*, Extensive Backfilling with Soil Reclamation Covers**	***Alternative Z6* Optimize Grading for Source Control (Preferred Alt.)**
South Alabama Pit *Blast to reduce and cover west wall of pit; backfill along lower east benches; grade to be free draining.*	Grade to recontour steep rubble backfill slopes. Cover pit floor with water barrier reclamation cover.	Cover with 24" NAG, 12" soil, and revegetate.	Same as Alt. Z2. Cover with 24" NAG, 7" Ruby tailings, 11" soil, and revegetate.	Almost totally backfilled. Cover with water balance reclamation cover.	Completely backfill the pit to approximate original contour. Cover with 10" Ruby tailings, 8" soil, and revegetate.	Lime amend top 24 " of fill as NAG. Cover graded areas with 6" Ruby tailings, 18" soil, and revegetate.
Ross Pit *Grade for free drainage; cover sulfide benches and walls with NAG fill.*	Cover pit floor with 12" NAG, 12" soil, and revegetate.	Same as Alt. Z1.	Same as Alt. Z1.	Backfill and grade half-way up pit wall. Cover with water barrier and water balance reclamation covers.	Completely backfill the pit to approximate original contour. Cover with 10" Ruby tailings, 8" soil, and revegetate.	Same as Alt. Z1. Cover graded areas with 12"-24" NAG, 6" Ruby tailings, 18" soil, and revegetate.
Leach Pads:						
Z79-81 Pad	Re-reclaim with water barrier or water balance reclamation cover if needed to prevent cover soil acidification.	Existing 8-12" soil reclamation cover left as final reclamation. Enhance existing vegetation.	Same as Alt. Z2.	Remove existing reclamation. Replace with water barrier and water balance reclamation covers.	Same as Alt. Z2.	Same as Alt. Z2.

Mine Feature ***Interim Reclamation Action***	***Alternative Z1*, Existing DEQ Reclamation Plans (FEIS Alt. 3 & 1998 ROD)**	***Alternative Z2*, Optimized Water Treatment within Bond Amounts**	***Alternative Z3*, Optimize Source Control within Bond Amounts**	***Alternative Z4*, Added Backfilling with Barrier Reclamation Covers**	***Alternative Z5*, Extensive Backfilling with Soil Reclamation Covers**	***Alternative Z6* Optimize Grading for Source Control (Preferred Alt.)**
Z82 Pad *Leach pad removed and backfilled in pits.*	Regrade slope on north side. Cover footprint with 12" NAG, 12" soil, and revegetate.	Regrade slope on north side. Lime amend top 24" of subgrade as NAG. Cover footprint and slope with 6" Ruby tailings, 18" soil, and revegetate.	Same as Alt. Z2.	Same as Alt. Z2.	Same as Alt. Z2.	Same as Alt. Z2.
Z83 Pad *Regraded to 3H:1V and covered with 24" NAG, 6" tailings, and 18" soil.*	Remove interim reclamation and replace with water barrier and water balance reclamation covers.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.
Z84 Pad *Regraded to 3H:1V and covered with 24" NAG, 6" tailings, and 18" soil.*	Remove interim reclamation and replace with water barrier and water balance reclamation covers.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.

Mine Feature ***Interim Reclamation Action***	***Alternative Z1*, Existing DEQ Reclamation Plans (FEIS Alt. 3 & 1998 ROD)**	***Alternative Z2*, Optimized Water Treatment within Bond Amounts**	***Alternative Z3*, Optimize Source Control within Bond Amounts**	***Alternative Z4*, Added Backfilling with Barrier Reclamation Covers**	***Alternative Z5*, Extensive Backfilling with Soil Reclamation Covers**	***Alternative Z6* Optimize Grading for Source Control (Preferred Alt.)**
Z85/86 Pad and Z85/86 Dike *Excavated portion for pit backfill; Regrade north area to 3H:1V slope; make free draining around the north edge.* *Put fill from drainage notch over Z85/86 Dike.*	Grade to 3H:1V slope with grading confined to lined area. Add fill to Z85/86 dike to make 2.5H:1V. Cover with water barrier and water balance reclamation covers.	Same as Z1. Cover with 24" NAG, 12" soil, and revegetate.	Same as Z1. Cover with 24" NAG, 7" tailings, 11" soil, and revegetate.	Same as Z1. Cover with water barrier and water balance reclamation covers.	Completely remove Z85/86 leach pad and dike for use as backfill. Cover footprint with 24" NAG, 10" tailings, 8" soil, and revegetate.	Excavate portion for pit backfill; Regrade remainder to 3H:1V make free draining around the north edge. Add fill to Z85/86 dike to achieve 2.5H:1V slope. Lime amend top 24" of subgrade as NAG. Cover regrade with 6" Ruby tailings, 18" soil, and revegetate.
Z89 Pad *Regraded to 3H:1V slope and covered with 24" NAG, 6" tailings, and 18" soil.*	Remove interim reclamation and replace with water barrier and water balance reclamation covers.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.	Interim reclamation cover left as final. Enhance existing vegetation on dike.

Mine Feature ***Interim Reclamation Action***	***Alternative Z1,*** **Existing DEQ Reclamation Plans (FEIS Alt. 3 & 1998 ROD)**	***Alternative Z2,*** **Optimized Water Treatment within Bond Amounts**	***Alternative Z3,*** **Optimize Source Control within Bond Amounts**	***Alternative Z4,*** **Added Backfilling with Barrier Reclamation Covers**	***Alternative Z5,*** **Extensive Backfilling with Soil Reclamation Covers**	***Alternative Z6*** **Optimize Grading for Source Control (Preferred Alt.)**
Waste Rock Dumps:						
Ruby Sulfide Stockpile *Backfilled in bottom of O.K. pit.*	Cover footprint with 12" NAG, 12" soil, and revegetate.	Cover footprint with 24" NAG, 12" soil, and revegetate.	Cover footprint with 24" NAG, 7" tailings, 11" soil, and revegetate.	Cover with 12" soil and revegetate.	Cover footprint with 24" NAG, 10" tailings, 8" soil, and revegetate.	Lime amend top 24" of footprint as NAG. Cover footprint with 6" Ruby tailings, 18" soil, and revegetate.
Z82 Sulfide Stockpile *Placed in bottom of O.K. pit.*	Would be covered by pit reclamation.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.
South Ruby Waste Rock Dump *Top removed and placed in pit. Bottom regraded to 3:1 in place.*	Cover footprint with 12" NAG, 12" soil, and revegetate.	Lime amend top 24" of footprint as NAG. Cover with 6" Ruby tailings, 18" soil, and revegetate.	Same as Alt. Z2.	Cover footprint with water barrier and water balance reclamation covers.	Lime amend top 24 " of footprint as NAG. Cover with 10" tailings, 8" soil, and revegetate.	Same as Alt. Z2.
O.K. Waste Rock Dump	Salvage soil. Remove and use as pit backfill. Lime footprint, cover with 12" soil, and revegetate.	Leave existing reclamation as final.	Same as Alt. Z2.	Salvage soil, regrade to 3H:1V, and cover with water balance reclamation cover.	Salvage soil, regrade to 3H:1V, cover with 10" tailings, 8" soil, and revegetate.	Salvage soil, regrade to 3H:1V. Lime amend top 24" of footprint as NAG then cover with 6" Ruby tailings, 18" soil, and revegetate.

Mine Feature ***Interim Reclamation Action***	***Alternative Z1*, Existing DEQ Reclamation Plans (FEIS Alt. 3 & 1998 ROD)**	***Alternative Z2*, Optimized Water Treatment within Bond Amounts**	***Alternative Z3*, Optimize Source Control within Bond Amounts**	***Alternative Z4*, Added Backfilling with Barrier Reclamation Covers**	***Alternative Z5*, Extensive Backfilling with Soil Reclamation Covers**	***Alternative Z6* Optimize Grading for Source Control (Preferred Alt.)**
Alder Gulch Waste Rock Dump	Salvage soil. Remove and use as pit backfill. Lime footprint and cover with 12" NAG, 12" soil, and revegetate.	Leave existing reclamation as final.	Same as Alt. Z2.	Same as Alt. Z1.	Salvage soil. Remove and use as pit backfill. Lime footprint and cover with 10" Ruby tailings, 8" soil, and revegetate.	Salvage soil. Remove 432,000 CY from top and use as pit backfill. Install water barrier cover over regraded excavation area.
Ruby Gulch Tailings:						
West Stockpile *Partially removed.*	Use as subsoil. Cover with 12" soil and revegetate.	Partial use as subsoil.	Same as Alt. Z1.	Same as Alt. Z1.	Use as subsoil. Cover with 8" soil and revegetate.	Same as Alt. Z1.
East Stockpile	Use as subsoil. Cover with 12" soil and revegetate.	Leave as is.	Same as Alt. Z1.	Same as Alt. Z1.	Use as subsoil. Cover with 8" soil and revegetate.	Same as Alt. Z1.
Tailings to Gate	Use as subsoil. Cover with 12" soil and revegetate.	Leave as is.	Same as Alt. Z2.	Same as Alt. Z1.	Use as subsoil. Cover with 8" soil and revegetate.	Partial removal for use as subsoil.
New Disturbance:						
Limestone Quarry LS-2	Develop 11-acre quarry to supply NAG material at LS-2 site.	No new disturbance. Limestone quarry would not be needed.	Same as Alt. Z2.	Develop 13-acre quarry to supply NAG material.	Same as Alt. Z2.	Same as Alt. Z2.
Goslin Flats	8-acre soil borrow area.	8-acre disturbance for water treatment plant.	None.	Same as Alt. Z2.	Same as Alt. Z2.	None.

Mine Feature ***Interim Reclamation Action***	***Alternative Z1*, Existing DEQ Reclamation Plans (FEIS Alt. 3 & 1998 ROD)**	***Alternative Z2*, Optimized Water Treatment within Bond Amounts**	***Alternative Z3*, Optimize Source Control within Bond Amounts**	***Alternative Z4*, Added Backfilling with Barrier Reclamation Covers**	***Alternative Z5*, Extensive Backfilling with Soil Reclamation Covers**	***Alternative Z6* Optimize Grading for Source Control (Preferred Alt.)**
Drainage Notch around Z85/86 Leach Pad	3.6 acres	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.
Seepage Capture and Water Treatment:						
Water Treatment Plant and Ponds	Continue to use at current location.	Move to Goslin Flats.	Same as Alt. Z1.	Same as Alt. Z2.	Same as Alt. Z2.	Same as Alt. Z1.
Capture Systems	Upgrade as indicated by monitoring to meet MPDES discharge requirements.	Same as Alt. Z1. Pipe captured water to Goslin Flats for treatment.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.
Leach Pad Process Water	Upgrade treatment system to treat for nitrates and selenium. Pump treated pad water to Goslin Flats LAD.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.
Reclamation Schedule and Labor:						
Reclamation Timeframe	1999-2003	1999-2002	1999-2002	1999-2004	1999-2006	1999-2003
Direct Reclamation Employment	11-21 people	17-23 people	17-23 people	17-23 people	17-23 people	26 people

Table 2.7-2. Landusky Mine Reclamation Alternatives Comparison

Mine Feature ***Interim Reclamation Actions***	***Alternative L1,*** **Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)**	***Alternative L2,*** **Optimize Earthwork within Bond Amount**	***Alternative L3,*** **Improved Pit Drainage Drill Hole**	***Alternative L4,*** **Remove & Backfill L85/86 Leach Pad (Preferred Alt.)**	***Alternative L5,*** **Pit Backfill to Cover Sulfide Highwalls**	***Alternative L6,*** **Pit Backfill to Restore Pre-Mine Contours**
General Reclamation Cover Description (see also Figure 2.4-2):						
Water Barrier Cover	Use on slopes flatter than 4H:1V over 24" neutral waste. Place a GCL, 36" NAG, 12" soil, and revegetate.	Not used except on floor of Suprise and Queen Rose pits.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2.	Use on slopes flatter than 4H:1V) over 24" neutral waste. Place a geosynthetic liner, 31" NAG, 15" soil, and revegetate.
Water Balance Cover	Use on slopes steeper than 4H:1V. Place 12" NAG, geotextile filter fabric, 36" soil, and revegetate.	Not used.	Not used.	Not used.	Not used.	Use on slopes steeper than 4H:1V. Place 19" NAG, geotextile filter fabric, 27" soil, and revegetate.
Soil Cover *Top 24" lime amended and covered with 6" tailings & 18" soil.*	12" NAG and 12" soil over acid generating footprints. 12" soil over non-acid generating surfaces. Revegetate cover.	6" NAG and 18" soil in pit complex. 24" NAG and 24" soil or 15" NAG and 24" soil over acid generating footprints. 12" or 24" soil over non-acid generating surfaces. Revegetate cover.	Same as Alt. L2.	24" NAG and 24" soil on most areas. NAG can be produced by lime amendment. 12" to 24" soil over non-acid generating native ground. Revegetate cover.	21" NAG and 25" soil or 24" NAG and 24" soil over acid generating footprints. 12" soil over non-acid generating surfaces. Revegetate cover.	12" or 24" soil over non-acid generating surfaces.

Mine Feature ***Interim Reclamation Actions***	***Alternative L1,*** **Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)**	***Alternative L2,*** **Optimize Earthwork within Bond Amount**	***Alternative L3,*** **Improved Pit Drainage Drill Hole**	***Alternative L4,*** **Remove & Backfill L85/86 Leach Pad (Preferred Alt.)**	***Alternative L5,*** **Pit Backfill to Cover Sulfide Highwalls**	***Alternative L6,*** **Pit Backfill to Restore Pre-Mine Contours**
Mine Pits						
August/Little Ben Pit	Cut drainage notch in SW end of pit and backfill to make free draining into Montana Gulch. Place 5' NAG on backfill. Cover fill with water barrier reclamation cover; Cover benches and notch with 0"-12" NAG, 12" soil, and revegetate.	Drain pit through artesian well WS3. Cover pit floor with 6" NAG, 18" soil, and revegetate.	Same as Alt. L2, but add a directional bore hole to ensure free draining. Cover pit floor with 6" NAG, 18" soil, and revegetate.	Drain pit through artesian well WS3 or directional bore hole. Backfill average 85 feet with L85/86 pad; Cover 900 linear feet of sulfide highwall with NAG fill. Lime amend subgrade to produce 24" NAG. Cover with 24" soil and revegetate.	Backfill the pit to be free draining. Cover sulfide highwalls with 3H:1V slopes. Place geosynthetic liner on pit floor. Cover with 21" NAG, 25" soil, and revegetate.	Backfill to pre-mine drainage with 3H:1V slopes. Place geosynthetic liner on pit floor. Cover with water barrier and water balance reclamation covers.
Suprise Pit *Partial backfill to make free draining (3% slope). Cover pit floor with GCL liner.*	Backfill to make free draining. Cover benches and backfill with water barrier cover.	Backfill benches and over liner with 24" NAG from August #2 east lobe, 18" soil, and revegetate. Backfill to cover sulfides with rubble slope.	Backfill benches and over liner with 24" NAG from August #2 east lobe, 18" soil, and revegetate. Backfill to cover sulfides with rubble slope.	Backfill benches and over liner with 24" NAG from August #2 east lobe, 18" soil, and revegetate. Backfill to cover sulfides with rubble slope.	Backfill to cover sulfide highwalls at 3H:1V slopes. Install groundwater recovery wells. Cover fill with 21" NAG, 25" soil, and revegetate.	Backfill to pre-mine drainage with 3H:1V slopes. Install groundwater recovery wells. Cover fill with water barrier and water balance reclamation covers.

Mine Feature ***Interim Reclamation Actions***	***Alternative L1,*** **Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)**	***Alternative L2,*** **Optimize Earthwork within Bond Amount**	***Alternative L3,*** **Improved Pit Drainage Drill Hole**	***Alternative L4,*** **Remove & Backfill L85/86 Leach Pad (Preferred Alt.)**	***Alternative L5,*** **Pit Backfill to Cover Sulfide Highwalls**	***Alternative L6,*** **Pit Backfill to Restore Pre-Mine Contours**
Queen Rose Pit *Place geosynthetic liner on pit floor. Backfill and grade to make free draining.*	Cover benches with 12"NAG, 12" soil, and revegetate. Cover pit floor with water barrier reclamation cover.	Cover pit floor backfill with 6" NAG, 18" soil, and revegetate. No bench covers.	Same as Alt. L2.	Lime amend bench to produce 24 " NAG; Cover with 24" soil. Cover pit floor with 24 " NAG and 24" soil. Revegetate.	Backfill to be free draining plus cover sulfide highwalls at 2H:1V slope. Cover fill with 21" NAG, 25" soil, and revegetate.	Backfill to pre-mine drainage with 3H:1V slopes. Cover fill with water barrier and water balance reclamation covers.
Gold Bug Pit *Regrade existing backfill to 3H:1V slopes. Blast highwall to cover sulfides.*	No cover on highwall rubble slope. Cover floor area with water barrier and water balance reclamation covers.	Cover floor with 24" NAG, 24" soil, and revegetate.	Same as Alt. L2.	Same as Alt. L2.	Import NAG fill to cover additional highwalls at 2H:1V slope. Cover fill with 21" NAG, 25" soil, and revegetate.	Backfill to the pre-mine drainage with 3H:1V slopes. Cover fill with water barrier and water balance reclamation covers.
South Gold Bug Pit *Reduce north and east pit wall by blasting and cover with rubble fill.*	Regrade backfill to 3H:1V slopes. Cover with water barrier and water balance reclamation covers	Regrade backfill to 3H:1V slopes. Cover with 24" NAG, 24" soil, and revegetate.	Same as Alt. L2.	Grade cut area, west benches and fill at 3H:1V slopes. Cover blast source area with 12" soil. Cover floor with 24" NAG, 24" soil, and revegetate.	Import NAG fill to cover sulfide highwalls at 2H:1V slopes. Cover with 21" NAG, 25" soil, and revegetate.	Backfill to the pre-mine drainage with 3H:1V slopes. Cover with water barrier and water balance reclamation covers.
Leach Pads:						
L79 Pad	Additional Revegetation.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.

Mine Feature ***Interim Reclamation Actions***	***Alternative L1,*** **Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)**	***Alternative L2,*** **Optimize Earthwork within Bond Amount**	***Alternative L3,*** **Improved Pit Drainage Drill Hole**	***Alternative L4,*** **Remove & Backfill L85/86 Leach Pad (Preferred Alt.)**	***Alternative L5,*** **Pit Backfill to Cover Sulfide Highwalls**	***Alternative L6,*** **Pit Backfill to Restore Pre-Mine Contours**
L80-82, L83, and L84 Pads plus L83 & L84 Dikes *Pads regraded at 3H:1V slopes. Top 24" lime amended & covered with 6" tailings & 18" soil. L84 Dike built out to 3H:1V slope.*	Remove interim reclamation and replace with water balance and water barrier reclamation covers. Additional revegetation on L83 dike.	Interim reclamation would be final. Additional revegetation on L83 dike.	Interim reclamation would be final. Additional revegetation on L83 dike.	Interim reclamation would be final. Additional revegetation on L83 dike.	Interim reclamation would be final. Additional revegetation on L83 dike.	Interim reclamation would be final. Additional revegetation on L83 dike.
L85/86 Pad and L85/86 Dike *Partial removal to build out L84 Dike and adjacent slope to the south.*	Regrade to 3H:1V slopes. Excavate a drainage channel along western edge to make free draining. Build out dike to a 2.5H:1V slope. Cover with water balance and water barrier reclamation covers.	3H:1V slope regrade of heap with limited drainage restoration. Build out dike to 2.5H:1V slope. Cover with 24" NAG, 24" soil, and revegetate.	Same as Alt. L1.	Complete removal of leach pad and dike for use as pit backfill: Test and lime amend native surface as required. Cover native ground with 24" soil and revegetate.	Complete removal of leach pad and dike for use as pit backfill: Test and lime amend native surface as required. Cover native ground with 12" soil and revegetate.	Same as Alt. L5.
L87 Pad	Regrade to overall 3H:1V slopes. Cap with water barrier and water balance reclamation covers.	Regrade to 2.5:1V slopes. Cover with 15" NAG, 24" soil, and revegetate.	Same as Alt. L2.	Regrade to 2.5:1V slopes. Cover with 24" NAG, 24" soil, and revegetate.	Use part for backfill of pit complex. Regrade remainder to max. 3H:1V slopes. Cover with 21"NAG, 25" soil, and revegetate.	Remove large portion for fill in pit complex. Regrade remainder to max. 3H:1V slopes. Cover with water barrier and water balance reclamation covers.

Mine Feature ***Interim Reclamation Actions***	***Alternative L1,*** **Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)**	***Alternative L2,*** **Optimize Earthwork within Bond Amount**	***Alternative L3,*** **Improved Pit Drainage Drill Hole**	***Alternative L4,*** **Remove & Backfill L85/86 Leach Pad (Preferred Alt.)**	***Alternative L5,*** **Pit Backfill to Cover Sulfide Highwalls**	***Alternative L6,*** **Pit Backfill to Restore Pre-Mine Contours**
L91 Pad and Dike *Extended liner into road cut to the east; Grade east side of leach pad.*	Regrade to overall 3H:1V slopes and cap. Build out L91 dike to 2.5H:1V slope using pad. Cover with water balance and water barrier reclamation covers.	Regrade to overall 2.5H:1V slopes on the leach pad. L91 dike left in current configuration. Additional revegetation of L91 dike. Cover with 15" NAG, 24" soil, and revegetate.	Same as Alt. L2.	Regrade to overall 2.5H:1V slopes on the leach pad. L91 dike left in current configuration. Additional revegetation of L91 dike. Cover with 24" NAG, 24" soil, and revegetate.	Remove part for backfill of pit complex. Regrade remainder to 3H:1V slopes. L91 dike left in current configuration. Additional revegetation of L91 dike. Cover with 21" NAG, 25" soil, and revegetate.	Remove large portion for backfill of pit complex. Regrade remainder to overall 3H:1V slope. L91 dike left in current configuration. Additional revegetation of L91 dike. Cover with water balance and water barrier reclamation covers.
Waste Rock Dumps:						
Mill Gulch Waste Rock Dump	Use soil stockpile on top. Extend existing water barrier reclamation cover over stockpile footprint. Additional revegetation on dump slope.	Leave soil reserve on top. Additional revegetation on dump slope.	Same as Alt. L2.	Same as Alt. L2.	Use soil stockpile on top. Extend existing liner to cover soil stockpile area. Cover with 21" NAG, 25" soil. Additional revegetation on dump slope.	Use soil stockpile on top. Cover with water balance and water barrier reclamation covers. Additional revegetation on dump slope.

Mine Feature ***Interim Reclamation Actions***	***Alternative L1,*** **Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)**	***Alternative L2,*** **Optimize Earthwork within Bond Amount**	***Alternative L3,*** **Improved Pit Drainage Drill Hole**	***Alternative L4,*** **Remove & Backfill L85/86 Leach Pad (Preferred Alt.)**	***Alternative L5,*** **Pit Backfill to Cover Sulfide Highwalls**	***Alternative L6,*** **Pit Backfill to Restore Pre-Mine Contours**
Montana Gulch Waste Rock Dump	Excavate top bench as drainage notch cut into August/Little Ben pit. Use excavation as backfill in August/ Little Ben pit. Cover top with water barrier reclamation cover.	Cover dump top with 15" NAG, 24" soil, and revegetate. Existing reclamation on dump slope would be left as final.	Same as Alt. L2.	Cover dump top with 24" NAG, 24" soil, and revegetate. Existing reclamation on dump slope would be left as final.	Cover dump top with 21" NAG, 25" soil, and revegetate. Existing reclamation on dump slope would be left as final.	Cover dump top with water barrier reclamation cover. Existing reclamation on dump slope would be left as final.
August #1 Waste Rock Dump *Use as NAG cover and to backfill adjacent benches. Regrade footprint to 2.7H:1V slopes.*	Cover with 12" soil and revegetate over NAG fill.	Cover with 24" soil and revegetate over NAG fill.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2.	Entire area is part of pit backfill. Cap with water balance and water barrier reclamation covers.
August #2 Waste Rock Dump	Excavate east lobe as NAG cover and fill source. Cover with 12" soil and revegetate. Reclamation on west lobe would be final.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Remove east and west lobes for use as NAG. Cover with 12" soil and revegetate.

Mine Feature ***Interim Reclamation Actions***	***Alternative L1,*** **Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)**	***Alternative L2,*** **Optimize Earthwork within Bond Amount**	***Alternative L3,*** **Improved Pit Drainage Drill Hole**	***Alternative L4,*** **Remove & Backfill L85/86 Leach Pad (Preferred Alt.)**	***Alternative L5,*** **Pit Backfill to Cover Sulfide Highwalls**	***Alternative L6,*** **Pit Backfill to Restore Pre-Mine Contours**
Gold Bug Yellow Waste Rock Dump *Regraded to 3H:1V slope*	Cover with water balance and water barrier reclamation covers and cap.	Cover with 24" NAG, 24" soil, and revegetate.	Same as Alt. L2.	Same as Alt. L2.	Remove for Backfill. Grade exposed bench at 3H:1V slope. Cover footprint with 21" NAG, 25" soil, and revegetate.	Buried by pit area backfill. Cap as part of pit with water barrier and water balance reclamation covers.
Lower Gold Bug Blue Waste Rock Stockpile	Excavate for use as NAG cover source. Cover with 12" soil and revegetate.	Excavate for use as NAG cover source. Cover with 24" soil and revegetate.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2.
Upper Gold Bug Blue Waste Rock Stockpile	Excavate for use as NAG cover source. Cover with 12" soil and revegetate.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Excavate for use as NAG cover. Cap as part of pit backfill with water barrier and water balance reclamation covers.
New Disturbance:						
Limestone Quarry	Develop two quarries to supply NAG material.	No new disturbance - quarry is not required.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2.
Gold Bug Highwall	3.6 acres	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.
Montana Gulch Drain	2 acres	None.	2 acres	None.	None.	None.

Mine Feature ***Interim Reclamation Actions***	***Alternative L1,*** **Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)**	***Alternative L2,*** **Optimize Earthwork within Bond Amount**	***Alternative L3,*** **Improved Pit Drainage Drill Hole**	***Alternative L4,*** **Remove & Backfill L85/86 Leach Pad (Preferred Alt.)**	***Alternative L5,*** **Pit Backfill to Cover Sulfide Highwalls**	***Alternative L6,*** **Pit Backfill to Restore Pre-Mine Contours**
Seepage Capture and Water Treatment:						
Water Treatment Plant	Continue to use at current location. Upgrade with biocircuit for nitrates and selenium.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.
Capture Systems	Upgrade as indicated by monitoring to meet MPDES discharge requirements.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.
Reclamation Schedule and Labor:						
Reclamation Timeframe	1999-2004	1999-2003	1999-2003	1999-2004	1999-2005	1999-2008
Direct Reclamation Employment	16-21 people	10-21 people	10-21 people	16-21 people	16-21 people	17-25 people

2.8 IMPACT SUMMARY COMPARISON TABLES

The following tables compare the environmental impacts of the existing conditions and the various reclamation alternatives for each mine. Table 2.8-1 compares the six reclamation alternatives analyzed for the Zortman Mine. Table 2.8-2 compares the six reclamation alternatives analyzed for the Landusky Mine. Additional detail on the impacts of each alternative is provided in Chapter 4.

Table 2.8-1. Summary of Environmental Impacts, Zortman Mine Reclamation

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Geotechnical Conditions (stability, erodibility and maintainability)							
Z79/80, Z83, Z84, & Z89 Leach Pads:							
Dikes	Intermediate, current condition is stable.	No Change	No Change	No Change	No Change	No Change	No Change
Heaps	Somewhat good. Interim reclamation has reduced heap slopes.	No Change	No Change	No Change	No Change	No Change	No Change
Liners	Intermediate, current liner is functioning.	No Change	No Change	No Change	No Change	No Change	No Change
Z82 Leach Pad:							
Heaps, Dike and Liner	Good. Leach pad was removed and backfilled during interim reclamation.	No Change	No Change	No Change	No Change	No Change	No Change
Z85/86 Leach Pad:							
Dike	Somewhat poor condition. Needs buttress for long-term stability.	Somewhat good. Dike resloped to 2.5H:1V would improve stability.	No Change	Somewhat good	Somewhat good	Good. Removal of pad dike for backfill eliminates stability concerns.	Somewhat good
Heap	Somewhat poor. Contains ungraded slopes.	Intermediate with heap slopes reduced to 3H:1V.	Somewhat poor with minimal reclamation cover and regrading.	Intermediate with regrading and reclamation cover.	Intermediate due to partial removal and slopes reduced to 3H:1V.	Good. Removal of heap backfill eliminates stability concerns.	Intermediate due to partial removal and slopes reduced to 3H:1V.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Liner	Intermediate, current liner is functioning.	No change	No change	No change	No change	Good due to removal of leach pad	No change
Waste Rock Dumps:							
Alder Gulch Waste Rock Dump	Somewhat poor due to history of past erosion problems on dump slope.	Good stability conditions with dump removal and placement as pit backfill.	No change	No change	Same as Alt. Z1.	Same as Alt. Z1.	Somewhat good due to partial removal and improved reclamation cover.
O.K. Waste Rock Dump	Intermediate stability condition. Dump has not been reclaimed.	Good stability conditions with dump removal and placement as pit backfill.	No change	No change	Somewhat good stability with regrade to 3H:1V slopes and revegetation.	Same as Alt. Z4.	Same as Alt. Z4.
South Ruby Waste Rock Dump	Good condition. Dump removed and used for backfill in interim reclamation.	No change	No change	No change	No change	No change	No change
Open Pits:							
North Alabama Pit	Intermediate stability condition.	No change	No change	No change	Good stability due to partial backfilling.	Good stability due to total pit backfilling.	Somewhat good stability due to partial backfilling.
South Alabama Pit	Somewhat good stability due to highwall reduction and partial backfilling.	No change	No change	No change	Good stability due to additional backfilling.	Good stability due to additional backfilling.	No change
O.K./Ruby and Mint Pits	Condition intermediate due to interim reclamation.	No change	No change	No change	No change	Condition improved to good with additional backfill.	No change

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Ross Pit	Intermediate stability condition.	No change	No change	No change	Condition improved to good with additional backfill.	Condition improved to good with additional backfill.	No change
Tailings:							
Ruby Gulch Tailings	Existing tailings highly erodible.	Removal and use of tailings would reduce erodibility to a low condition.	No change	No change	Same as Alt. Z1.	Same as Alt. Z1.	Condition improved to average erodibility with most of the tailings removed.
Water Resources and Geochemistry							
Infiltration of Precipitation:							
Total Mine Ave. Infiltration (gpm)	266	126	156	149	138	143	127
% Reduction from Existing Infiltration	0%	53%	41%	44%	48%	46%	52%
Total Pit Ave. Infiltration (gpm)	55	17	33	31	22	29	21
% Reduction from Existing Infiltration	0%	69%	40%	44%	60%	47%	62%
Sulfate Load Reduction (% from existing load):							
Lodgepole Creek	0%	35%	0%	10%	increases by 2,650%	increases by 3,350%	50%
Carter Gulch	0%	88%	0%	0%	87%	88%	88%
Alder Spur	0%	0%	0%	0%	0%	0%	0%
Ruby Creek	0%	46%	8%	4%	35%	27%	35%
Surface Water Quality:							

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Alder Spur	Moderately low impacts due to capture system operation.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
Carter Gulch	Intermediate impacts due to capture system operation.	Moderately low impacts with removal of Alder Gulch waste rock.	No change from existing conditions.	No change from existing conditions.	Same as Alt. Z1.	Same as Alt. Z1.	Moderately low impacts with partial dump removal and improved reclamation cover on dump top.
Ruby Gulch	Moderately high impacts due to uncaptured pit recharge.	Moderately low impacts due to significant reduction in pit and mine recharge.	Moderately high impacts due to lower quality covers and uncaptured pit recharge.	Moderately high impacts due to lower quality covers and uncaptured pit recharge.	Moderately low impacts due to use of HDPE/PVC liners resulting in decreased infiltration in the pits.	Moderately low impacts with use of water barrier covers and removal of the Z85/86 leach pad and dike.	Intermediate impacts with use of water balance water barrier covers and removal of the tailings.
Lodgepole Creek	Moderately low impacts due to runoff routed away from drainage.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	Intermediate impacts due to poor quality backfill in Ross pit.	Same as Alt. Z4.	Low impacts due to use of thicker reclamation covers.
Surface Water Quantity:							
Alder Spur	High impacts due to need for ongoing seepage capture.	Moderately high impacts with increases in runoff from reclamation covers.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Carter Gulch	Moderately low impacts due to stream water diversions and low flows into capture system.	Low impacts with removal of Alder Gulch waste rock dump and capture system.	No change from existing conditions.	No change from existing conditions.	Same as Alt. Z1.	Same as Alt. Z1.	No change from existing conditions.
Ruby Gulch	Moderately low impacts with release of treated water in upper Ruby Gulch.	No change from existing conditions.	Moderately high impacts from moving treatment plant and release point to Goslin Flats.	No change from existing conditions.	Intermediate impacts from moving treatment plant and release point to Goslin Flats.	Intermediate impacts from moving treatment plant and release point to Goslin Flats.	No change from existing conditions.
Lodgepole Creek	Moderately low impacts to water quantity due to the relatively small area impacted by Ross pit.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	Low impacts to water quantity with restoration of the small runoff area into Lodgepole Creek.	Same as Alt. Z4.	No change from existing conditions.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Groundwater Quality:							
Alder Spur	Intermediate impacts with function of capture system.	No change from existing condition.	No change from existing condition.	No change from existing condition.	No change from existing condition.	No change from existing condition.	No change from existing condition.
Carter Gulch	Intermediate impacts with function of capture system.	Low impacts with removal of Alder waste rock dump contaminant source from the drainage.	No change from existing condition.	No change from existing condition.	Same as Alt. Z1.	Same as Alt. Z1.	Moderately low impacts due to partial removal of the Alder waste rock dump from the drainage.
Ruby Gulch	Moderately high impacts with infiltration through pit floors reporting to Ruby Gulch.	Moderately low impacts with barrier cover on pit floors and use of water capture system.	Intermediate impacts with soil covers in pit areas and capture system.	Same as Alt. Z2.	Moderately low impacts with barrier covers over backfilled pit areas and use of water capture system.	Intermediate impacts with soil covers and removal of Z85/86 leach pad from drainage.	Moderately low impacts with improved grading and reclamation covers.
Lodgepole Creek	Moderately low impacts with routing of surface flow away from Lodgepole Creek which limits infiltration in the pit.	Low impacts due to covering sulfide pit benches and floors with NAG material and soil.	Same as Alt. Z1.	Same as Alt. Z1.	Intermediate impacts due to increased backfill in Ross pit at head of the drainage.	Same as Alt. Z4.	Same as Alt. Z1.
Water Management:							
Stormwater Control (stability and maintainability)	Intermediate stability of existing stormwater controls.	Somewhat good long-term stability of stormwater controls.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.	Same as Alt. Z1.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Seepage Collection (operating and maintenance difficulty)	High operating requirements due to unreclaimed conditions. Intermediate maintenance needs.	Somewhat high operating requirements. Intermediate maintenance needs.	Intermediate operating requirements. Somewhat low maintenance needs due to easier pumping to Goslin Flats site.	High operating requirements. Intermediate maintenance needs.	Somewhat low operating requirement. Somewhat low maintenance requirements.	Somewhat low operating require-ments. Possible need for capture facility in Ross Gulch. Somewhat low maintenance requirements.	Same as Alt. Z1.
Water Treatment Plant Operations (operating and sludge disposal difficulty)	High operating requirements. Somewhat easy sludge disposal.	Somewhat low operating requirements. Somewhat easy sludge disposal.	Intermediate operating require-ments with easy access at Goslin Flats site. Sludge disposal somewhat difficult due to transport back to mine site.	Intermediate operating requirements. Somewhat easy sludge disposal.	Somewhat low operating requirements. Somewhat difficult sludge disposal.	Same as Alt. Z4.	Same as Alt. Z3.
Water Treatment Plant Acidity Load	High	Somewhat low	Somewhat high	Somewhat high	Intermediate	Intermediate	Intermediate
LAD Water Quality and Quantity	High quality due to acid, metal, nitrate & selenium pretreatments. Volume would be somewhat high due to unfinished heap reclamation.	Same quality as existing conditions. Volume somewhat low with use of barrier reclamation covers on heaps.	Same quality as existing conditions. Volume somewhat high with soil covers on heaps.	Same quality as existing conditions. Volume reduced to intermediate with better covers on heaps.	Same quality as existing conditions. Volume somewhat low with barrier reclamation covers on heaps.	Same quality as existing conditions. Volume somewhat low with Z85/86 and Z82 heaps used for backfill.	Same quality as existing conditions. Volume intermediate with improved reclamation covers on heaps.

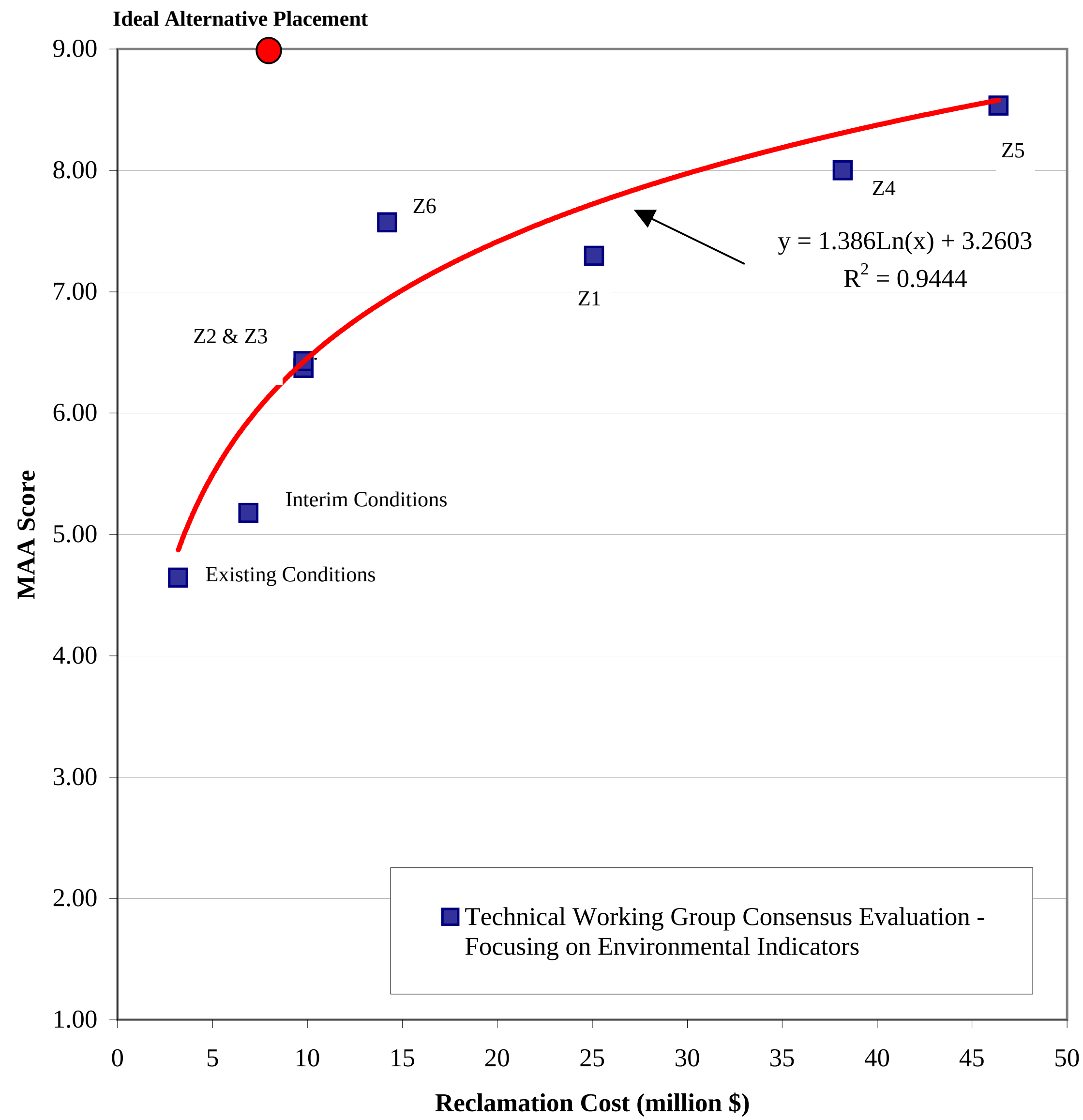
Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Soil and Reclamation Materials							
Reclamation Cover Durability	Somewhat good long-term durability of the present covers (which are just rock).	Somewhat poor durability due to potential breakdown of GCL.	Somewhat good durability with use of soil covers.	Same as Alt. Z2.	Somewhat poor durability due to potential breakdown of synthetics in barrier cover.	Same as Alt.Z2.	Intermediate long-term durability with the combination of reclamation covers.
New Disturbances	3.2 acres of new disturbance for construction of the Z85/86 drainage notch during interim reclamation.	Development of an 11-acre limestone quarry to supply reclamation material. 8-acre soil borrow Goslin Flats.	New 8 acres disturbance on Goslin Flats to relocate water treatment plant.	Same as existing conditions	New 13-acre disturbance for limestone quarry and to move water treat-ment plant. 8-acre soil borrow Goslin Flats.	Same as Alt. Z2.	Same as existing conditions
Vegetation and Revegetation							
Disturbance Area Revegetated	36%	84%	79%	79%	85%	88%	79%
Revegetation Density, Diversity and Sustainability	Somewhat poor. Not all areas adequate.	Somewhat good	Intermediate	Somewhat good	Good	Good	Good
Wildlife and Aquatics							
Reclamation Value as Wildlife Habitat	Somewhat low	Intermediate	Intermediate due to removal of water treatment plant and associated light and noise to Goslin Flats.	Intermediate	High	High	Somewhat high

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Land Use							
Long-Term Management Needs	High. Continual care and maintenance for unreclaimed lands.	Somewhat high with barrier cover maintenance and uphill pumping.	Intermediate	Somewhat high due to maintenance of pumping system and uphill pumping.	Same as Alt. Z2	Same as Alt. Z2	Somewhat high
Mineral Development Potential	Potential reduced from somewhat high at mine closure to intermediate with interim backfilling.	Somewhat low with increased backfilling of pit area.	Intermediate. Similar to existing conditions.	Same as Alt. Z2.	Low potential for future mineral development with the added backfill.	Low potential for future mineral development with the extensive backfill.	Somewhat low with partial backfilling of all pits.
Recreation and Visual Resources							
General Aesthetic Condition of Reclaimed Mines	Somewhat low due to unreclaimed areas and pit highwalls.	Intermediate due to backfilling of some pit areas.	Somewhat low	Intermediate. Impact similar to Alt. Z1, though less backfilling.	Somewhat high with the added pit backfilling.	High due to restored landform and elimination of pit highwalls.	Somewhat high with the added grading and pit backfilling.
Hunting, Tourism or other Recreational Suitability	Low to somewhat low suitability.	Intermediate	Intermediate to somewhat high	Same as Alt. Z1.	Somewhat high	Same as Alt. Z4.	Intermediate to somewhat high.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Cultural Resources							
Usability for Traditional Cultural Practices	Low. Areas still unreclaimed. Equipment active.	Somewhat low	Somewhat low	Somewhat low	Intermediate	Somewhat high	Intermediate
Social and Economic Conditions							
Study Area Economy	Year 2000 averaged 31 jobs and $622,000 in total industry output.	21-40 jobs and $753,000 to $1.2 million annually in total industry output over 3-year period (2001-2003).	46 jobs and $1.5 million annually in total industry output over 1 year (2001).	54 jobs and $2.2 million annually in total industry output over 1 year (2001).	37-41 jobs and $1.1 million to $1.3 million annually in total industry output over 4-year period (2001-2004).	38-49 jobs and $1.1 million to $1.4 million annually in total industry output over 6-year period (2001-2006).	47-54 jobs and $1.3 million to $2.2 million annually in total industry output over 2-year period (2001-2002).
Zortman Community Infrastructure Condition	Low	Intermediate. Removal of tailings through town would improve distribution water system and reduce flooding potential.	No change	No change	Intermediate. Same as Alt. Z1.	Intermediate. Same as Alt. Z1.	Somewhat low with no tailings removal through town.
Reclamation Worker Health and Safety	High level of worker protection with just interim reclamation work.	Somewhat low protection. Alder Dump removal difficult.	Somewhat high protection with this reclamation effort.	Same as Alt. Z2	Somewhat low protection due to increased amount of reclamation duration.	Somewhat low worker protection. Similar to Alt. Z4.	Intermediate
Public Health and Safety Post-Reclamation	Intermediate. Existing conditions contain hazards.	Intermediate	Intermediate. Similar to Alt. Z1.	Intermediate. Similar to Alt. Z1.	Somewhat high with reduction of pit highwall height.	High public safety with elimination of pit highwalls.	Somewhat high with the reduction of the pit highwall height.
Long-Term Employment Value	Somewhat high due to need for continual water treatment plant operation.	Intermediate. Less need for water treatment plant operation over existing conditions.	Somewhat low. Treatment plant at Goslin Flats would require less personnel to operate.	Intermediate. Similar to Alt. Z1.	Somewhat low. Similar to Alt. Z2.	Somewhat low. Similar to Alt. Z2.	Intermediate. Similar to Alt. Z1.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Total Reclamation Expenditures	$6.9 million spent on interim reclamation.	$25.6 million	$10.0 million	$10.0 million	$39.0 million	$47.2 million	$15.0 million
Percentage of Reclamation Costs Attainable within Bond Amount	na	39%	100%	100%	26%	21%	67%
Long-Term Water Collection and Treatment Costs (required net present value of trust fund)	$12.4 million	$11.8 million	$10.8 million	$12.3 million	$10.6 million	$10.6 million	$11.8 million
Long-Term Water Management Costs Attainable with Present Trust Fund	56%	58%	64%	56%	65%	65%	58%

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative Z1***, Existing DEQ Reclamation Plans (FEIS Alt.3 & 1998 ROD)	***Alternative Z2***, Optimized Water Treatment within Bond Amounts	***Alternative Z3***, Optimize Source Control within Bond Amounts	***Alternative Z4***, Added Backfilling with Barrier Reclamation Covers	***Alternative Z5***, Extensive Backfilling with Soil Reclamation Covers	***Alternative Z6***, Optimize Grading for Source Control (Preferred Alt.)
Alternative Ranking from Multiple Account Analysis Scores (from Appendix A)							
Technical Working Group's Overall Evaluation	7	4	4	6	3	1	1
Technical Working Group Evaluation without Economic Indicators	7	4	5	5	2	1	3
Cost-Benefit Evaluation Ranking. (environmental benefit vs. cost)	7	4	2	3	5	6	1



Interim conditions and Alt Z1 not included in logarithmic curve fitting

FIGURE 2.8-1 - MAA SCORES VERSUS RECLAMATION COST FOR THE ZORTMAN RECLAMATION ALTERNATIVES

Table 2.8-2. Summary of Environmental Impacts, Landusky Mine Reclamation

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
Geotechnical Conditions (stability, erodibility, & maintainability)							
Lower Leach Pads L79, L80/81/82, L83, L84:							
Dikes	Somewhat good. Interim reclamation has improved stability.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
Heaps	Somewhat good. Interim reclamation has improved stability from somewhat poor.	Somewhat good but more difficulty maintaining barrier covers.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
Liners	Intermediate durability.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
L85/86 Leach Pad:							
Dikes	Intermediate stability.	Improve stability to somewhat good with buildout to 2.5H:1V slopes.	Same as Alt. L1.	Same as Alt. L1.	Stability improved to good with removal of dike.	Same as Alt. L4.	Same as Alt. L4.
Heaps	Interim reclamation improve stability from somewhat poor to intermediate.	Intermediate with GCL in reclamation cover.	Somewhat good with no GCL.	Same as Alt. L2.	Heap stability improved to good with removal and placement as backfill.	Same as Alt. L4.	Same as Alt. L4.
Liners	Intermediate functioning.	Same as existing condition.	Same as existing condition.	Same as existing condition.	Removal of liner improves function to good.	Same as Alt. L4.	Same as Alt. L4.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
L87/91 Leach Pad:							
Dikes	Intermediate stability.	Somewhat good with built out L91 dike.	Same as existing conditions.	Same as existing conditions.	Same as existing conditions.	Somewhat good due to slight reduction in load behind dikes and additional revegetation.	Somewhat good due to reduction in load behind dikes and additional revegetation.
Heaps	Intermediate stability due to some regrading.	Stability improved to somewhat good with 3H:1V slopes.	Intermediate stability with regrade to 2.5H:1V slopes.	Same as Alt. L2.	Same as Alt. L2.	Stability improved to good with some heap material removed.	Similar to Alt. L5.
Liners	Intermediate, functioning.	Same as existing condition.	Same as existing condition.	Same as existing condition.	Same as existing condition.	Same as existing condition.	Same as existing condition.
Waste Rock Dumps:							
August #1 and #2 Waste Rock Dumps	Somewhat good as dumps are reclaimed or graded.	Somewhat good. Partial removal but reclaimed on steep slopes.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Good stability with use as backfill.
Montana Gulch Waste Rock Dump	Intermediate condition with top disturbed.	Somewhat good condition with partial removal and top reclaimed.	Intermediate with top reclaimed.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2.
Mill Gulch Waste Rock Dump	Somewhat good condition.	Somewhat good condition with added revegetation.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.
Gold Bug Repository	Existing condition is intermediate.	Intermediate with grading and covering of dump top.	Somewhat good with grading and covering of dump top.	Same as Alt. L2.	Same as Alt. L2.	Good with dump removed.	Good with dump buried in pit backfill.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
Open Pits:							
Queen Rose Pit	Somewhat poor stability conditions.	Somewhat poor with grading limited to the pit floor.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Somewhat good due to backfilling.	Good due to large amount backfilling.
August/Little Ben Pit	Somewhat poor stability conditions.	Somewhat poor with grading limited to the pit floor.	Same as existing conditions.	Somewhat poor with limited highwall backfilling.	Intermediate with more backfilling on pit floor and walls.	Somewhat good due to backfilling.	Good due to large amount backfilling.
Gold Bug Pit	Somewhat poor stability conditions.	Intermediate with grading limited to pit floor and highwall reduction to cover sulfides.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Somewhat good due to backfilling.	Good due to large amount backfilling.
South Gold Bug Pit	Somewhat poor stability conditions.	Somewhat poor with grading limited to the pit floor.	Same as Alt. L1.	Same as Alt. L1.	Somewhat good due to highwall reduction.	Somewhat good due to backfilling.	Good due to large amount of backfilling.
Water Resources and Geochemistry							
Infiltration of Precipitation:							
Total Mine Ave. Infiltration (gpm)	747	233	295	297	289	287	188
% Reduction from Existing Infiltration	0%	69%	61%	61%	61%	62%	75%
Total Pit Ave. Infiltration (gpm)	194	73	95	96	89	84	34
% Reduction from Existing Infiltration	0%	62%	51%	51%	54%	57%	82%

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
Sulfate Load Reductions (% from existing load):							
King Creek	0%	2%	2%	2%	3%	increases by 129%	increases by 227%
Swift Gulch	0%	39%	36%	36%	36%	increases by 66%	increases by 119%
Montana Gulch	0%	52%	22%	22%	22%	20%	28%
Mill Gulch	0%	45%	2%	2%	2%	3%	31%
Sullivan Gulch	0%	12%	0%	0%	0%	0%	0%
Surface Water Quality:							
Upper Swift Gulch	Intermediate impacts due to worsening shear zone water quality from unreclaimed pit area.	Moderately low impacts due to GCL covers over Queen Rose pit and pit benches.	Intermediate impacts due to water balance covers but no barrier covers. Pit sulfides still exposed.	Moderately low impacts due to thicker water balance covers on pit benches and NAG highwall cover.	Same as Alt. L3	Intermediate impacts due to backfill of sulfide rock into Suprise and Queen Rose pits.	Moderately high impacts due to possible leaching of sulfide backfill and drainage to north.
King Creek	Intermediate impacts due to the presence of the August #2 waste rock dump.	Moderately low impacts with removal of the east lobe of the August 2 rock dump.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Contaminant load to King Creek increases due to pit backfill.	Moderately high impacts due to possible leaching of the pit backfill.
Sullivan Gulch	Intermediate impacts due to occasional ARD bypasses of capture system.	Intermediate impacts if acid generating materials are used to buildout the L91 dike.	Moderately low impacts with the added revegetation on the L91 dike.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2	Same as Alt. L2.
Mill Gulch	Intermediate impacts due to occasional ARD bypasses of capture system..	Moderately low impacts with the enhanced covers.	Same as Alt. L1	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
Montana Gulch	Moderately high impacts due to presence of L85/86 leach pad and underdrains and existing highwalls.	Moderately high impacts due to excavation of the pit drainage notch exposing sulfides.	Intermediate impacts with reclamation of leach pad surface.	Same as Alt. L2, but directional borehole provides backup feature to help prevent formation of pit lake.	Low impacts due to L85/86 pad removal, restoration of natural drainage, and more coverage of pit highwalls.	Moderately low impacts due to L85/86 pad removal and creation of a free-draining pit. Sulfides placed in pit increases risk over L4.	Same as Alt. L5.
Surface Water Quantity:							
Upper Swift Gulch	Moderately high impacts to flow due to interception by mine pits and with WS-3 well open.	No change due to surface drainage routed to south.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Moderately low impacts with restored pit topography which restores runoff flows.
King Creek	Moderately high impacts to flow due to interception by mine pits.	No change due to surface drainage routed to south.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Low impacts due to restored pit topography which restores runoff flows.
Sullivan Gulch	Moderately high impacts to flow due to interception by leach pad.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
Mill Gulch	Moderately high impacts to flow due to interception by leach pad.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
Montana Gulch	Low impacts to flow with water treatment plant discharges.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	Moderately low impacts due to less capture for treatment.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
Groundwater Impacts:							
Upper and Lower Swift Gulch	Intermediate impacts due to reduced recharge to seeps in Swift Gulch from interim reclamation liner on pit floor.	Moderately low impacts due to barrier cover over pit backfill.	Moderately low impacts due to sulfides in Suprise pit being covered with backfill, improved soil covers, and GCL pit floor liner.	Same as Alt. L2.	Same as Alt. L2.	Moderately high impacts with placement of sulfidic L87 spent ore backfill at head of drainage.	Moderately high impacts from large amount of L87/91 spent ore backfilled at head of drainage and more shallow seepage to north.
King Creek	Intermediate impacts due to August #2 waste rock dump and poor quality pit rim infiltration.	Moderately low impacts with removal of August #2 waste rock dump east lobe.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Contaminant loads to King Creek would increase due to pit backfill.	Moderately high impacts from acidic backfill at head of drainage and potential shallow seepage to creek.
Sullivan Gulch	Intermediate impacts due to occasional ARD bypasses of capture system.	Intermediate impacts if acid generating materials are used to buildout the L91 dike.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
Mill Gulch	Intermediate impacts on alluvial and bedrock aquifers due to occasional capture system bypasses.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
Montana Gulch	Intermediate impacts from high infiltration to August and Gold Bug pit areas and some uncaptured groundwater flow.	Low impacts with extensive GCL cover use and free-draining pit. Sulfides in pit drainage notch may offset this benefit.	Moderately low impacts with reclamation covers over pits and other areas.	Same as Alt. L2.	Low impacts with removal of L85/86 leach pad from the drainage, improved covers and partial highwall coverage.	Intermediate impacts due to removal of the L85/86 leach pad offset by use of acid-forming backfill.	Same as Alt. L5.

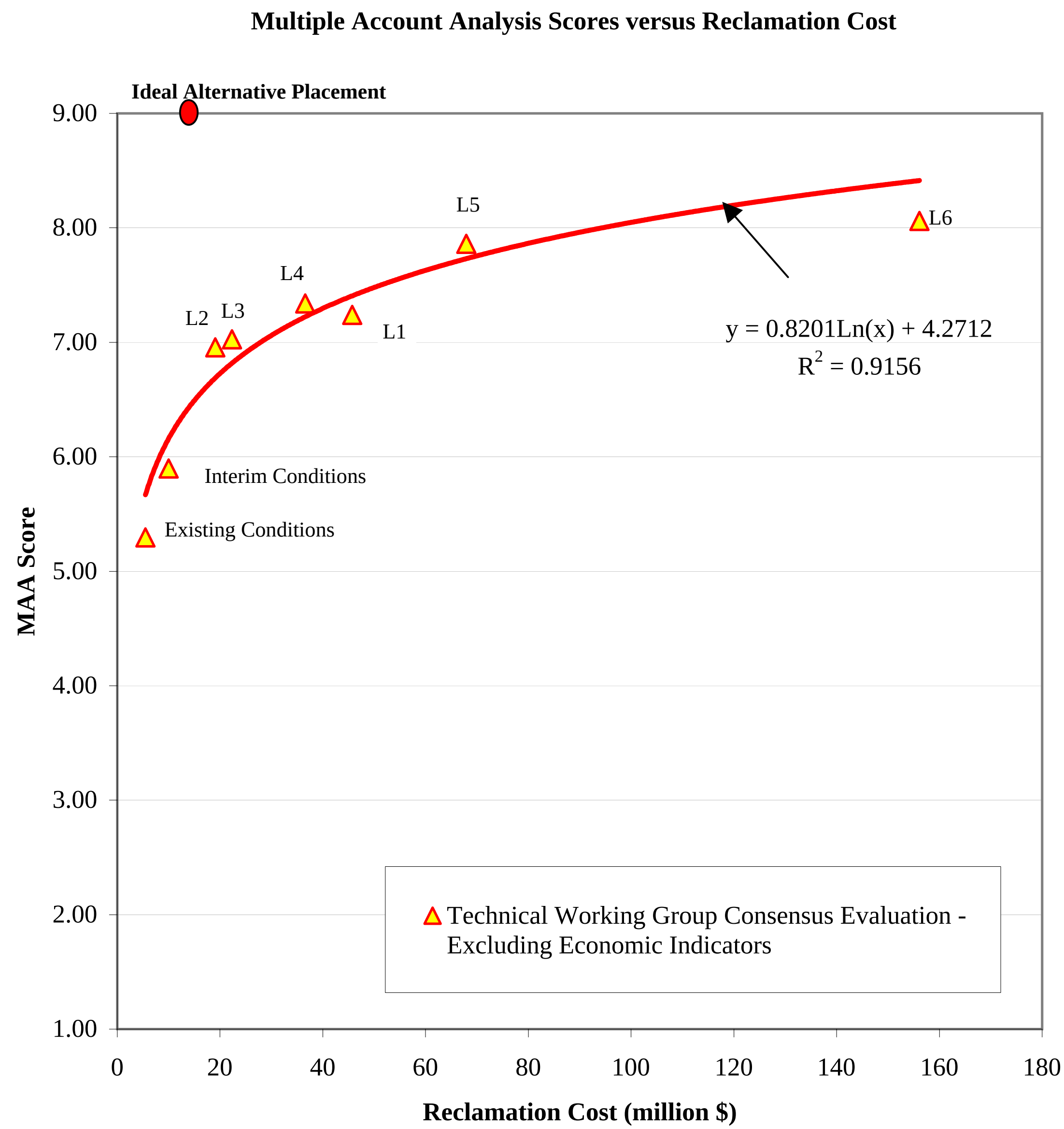
Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
Water Management:							
Stability of Workings Used for Pit Drainage	Somewhat poor. Artesian well only.	Somewhat good with use of drainage notch.	Somewhat poor with soil cover over the pit floor.	Intermediate, with backup drainage borehole.	Intermediate, similar to Alt. L3.	Good. Most drainage via surface runoff.	Same as Alt. L5.
Stormwater Control Maintenance Requirements	Intermediate	Somewhat low	Somewhat low	Somewhat low	Somewhat low	Somewhat low	Intermediate. Backfilled slopes may be difficult to manage.
Seepage Collection (operating and maintenance difficulty)	Intermediate. System functioning adequately.	No change	No change	No change	No change	Difficulty increased to somewhat high with added capture system in pit area.	Same as Alt. L5.
Water Treatment Plant Operations (operating requirements and sludge disposal)	Somewhat high operating requirements. Somewhat easy sludge disposal.	Somewhat low operating requirements with less volume. Somewhat easy sludge disposal.	Intermediate operating requirements. Sludge disposal is somewhat easy.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L1.	Same as Alt. L1.
Water Treatment Plant Acidity Load	High	Somewhat low	Somewhat high	Somewhat high	Somewhat high	High	High
LAD Water Quality and Quantity	High load and somewhat high volume.	High load and intermediate volume.	Same as Alt. L1.	Same as Alt. L1.	High load and somewhat low volume.	Same as Alt. L4.	High load and low volume.
Soil and Reclamation Materials							
Reclamation Cover Durability	Somewhat good.	Somewhat poor with use of GCL.	Somewhat good.	Somewhat good.	Somewhat good.	Somewhat good.	Somewhat poor due to synthetic.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
New Disturbances	Gold Bug highwall 3.6 acres.	Possible two new limestone quarries. 2 acres for Montana Gulch drainage.	No new disturbances.	2 acres for Montana Gulch drainage.	Same as Alt. L2.	Same as Alt. L2.	Same as Alt. L2.
Vegetation and Revegetation							
Disturbance Area Revegetated	40%	81%	78%	78%	81%	85%	92%
Revegetation Density, Diversity, and Sustainability	Somewhat poor density with intermediate diversity and sustainability.	Somewhat good density with intermediate diversity and sustainability.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Good density with somewhat high diversity and sustainability.	Same as Alt. L5.
Wildlife and Aquatics							
Reclamation Value as Wildlife Habitat	Intermediate	Somewhat high	Somewhat high	Somewhat high	Somewhat high	High	High
Land Use							
Long-Term Management Needs	High. Unreclaimed areas would need a lot of maintenance.	Somewhat high. Long term water treatment need indefinite.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.
Mineral Development Potential	Somewhat high. Not much backfill over deposit.	Intermediate	Intermediate	Intermediate	Intermediate	Somewhat low. Backfilling makes future mining unlikely.	Low. Extensive backfill make future mining unlikely.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
Recreation and Visual Resources							
General Aesthetic Condition of Reclaimed Mine	Somewhat low due to unreclaimed areas.	Somewhat low due to highwall areas.	Same as Alt. L1.	Same as Alt. L1.	Intermediate.	Somewhat high with more backfilling in pits.	High, backfilling eliminates pit highwalls.
Hunting, Tourism or other Recreational Suitability	Somewhat low. Area closed to public use.	Intermediate. Some use restrictions would still be needed.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Somewhat high. Minor use restrictions needed.	Somewhat high. Minimal use restrictions needed.
Cultural Resources							
Usability for Traditional Cultural Practices	Low. Existing disturbance not suitable.	Somewhat low due to remaining pit highwalls.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Intermediate with partial backfilling.	Somewhat high due to increased backfilling.
Social and Economic Conditions							
Study Area Economy	Year 2000 average employment of 31 jobs and $622,000 in total industry output.	35-48 jobs and $1.3 million to $1.6 million annually in total industry output over 4-year period (2001-2004).	31-50 jobs and $1.3 million to $1.8 million annually in total industry output over 3-year period (2001-2003).	30-50 jobs and $1.3 million to $1.8 million annually in total industry output over 3-year period (2001-2003).	36-49 jobs and $1.4 million to $1.7 million annually in total industry output over 4-year period (2001-2004).	35-48 jobs and $1.3 million to $1.7 million annually in total industry output over 5-year period (2001-2005).	43-54 jobs and $1.4 million to $1.8 million annually in total industry output over 8-year period (2001-2008).
Landusky Community Infrastructure Condition	Somewhat high. Water supplies not impacted.	Same as existing conditions.	Same as existing conditions.	Same as existing conditions.	Same as existing conditions.	Same as existing conditions.	Same as existing conditions.
Health and Safety of Reclamation Workers	Somewhat high.	Intermediate. Cutting drainage notch is difficult.	Somewhat high.	Somewhat high.	Somewhat high.	Somewhat low.	Low due to extensive amount of work over time.

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
Public Health and Safety Post-Reclamation	Intermediate.	Somewhat high.	Somewhat high.	Somewhat high.	Somewhat high.	High with elimination of pit highwalls.	Same as Alt. L5.
Long-Term Employment Value	Somewhat high if site to be maintained in existing condition.	Intermediate value with continued site maintenance and treatment needs.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.	Same as Alt. L1.
Total Reclamation Expenditures	$10 million spent on interim reclamation.	$46.2 million	$19.6 million	$22.8 million	$37.1 million	$68.5 million	$157.3 million
Percentage of Reclamation Costs Attainable within Bond Amount	na	42%	100%	86%	53%	29%	12%
Long-Term Water Collection and Treatment Costs (required net present value of trust fund)	$12.4 million	$11.4 million	$11.9 million	$11.9 million	$11.9 million	$11.9 million	$11.8 million
Long-Term Water Management Costs Attainable with Present Trust Fund.	56%	61%	58%	58%	58%	58%	58%

Affected Resource or Mine Feature	**Existing Condition** (February 2001)	***Alternative L1***, Existing DEQ Reclamation Plans (FEIS Alt. 3 and 1998 ROD)	***Alternative L2***, Optimize Earthwork within Bond Amount	***Alternative L3***, Improved Pit Drainage Drill Hole	***Alternative L4***, Remove & Backfill L85/86 Leach Pad (Preferred Alt.)	***Alternative L5***, Pit Backfill to Cover Sulfide Highwalls	***Alternative L6***, Pit Backfill to Restore Pre-mine Topography
Alternatives Ranking from Multiple Account Analysis Scores (from Appendix A)							
Technical Working Group's Overall Evaluation	7	3	5	3	1	1	6
Technical Working Group Evaluation without Economic Indicators	7	4	5	5	3	2	1
Cost-Benefit Evaluation Ranking. (environmental benefit vs. cost)	6	4	1	2	3	5	7



Interim & Alt L1 not included in logarithmic curve fitting

FIGURE 2.8-2 - MAA SCORES VERSUS RECLAMATION COST FOR THE LANDUSKY RECLAMATION ALTERNATIVES